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AGENCY REVIEW DRAFT

TECHNICAL MEMORANDUM NO. 3

VARIABLE HEAD HYDRAULIC CONDUCTIVITY TESTING
AND ANALYSIS

ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION

MARCH 30, 1989

GLT853/14-1

CH2M Engineers Planners Economists Scientists

March 30, 1989

GL065556.TS.PT

Ms. Karen Vendl
U.S. Environmental Protection Agency,
Region V, 5HR-11
230 South Dearborn Street
Chicago, Illinois 60604

Dear Ms. Vendl:

Subject: Environmental Conservation and Chemical Corporation
Agency Review Draft
Technical Memorandum No. 3
WA No. 08-5N30.0

We are pleased to submit 5 copies of Agency Review Draft Technical Memorandum No. 3, Variable Head Hydraulic Conductivity Testing and Analysis for Environmental Conservation and Chemical Corporation.

Sincerely,

Alpheus Sloan III
Site Manager

pk/GLT592/55
Enclosures
cc: Lorraine Kosik, U.S. EPA Region V (w/o enclosure)
Glen Pratt, IDEM, Indianapolis
John Buck, IDEM, Indianapolis
John Fleissner, PM, Milwaukee
Randy Videkovich, APM-OPNS, Milwaukee
David Lane, RTL, Milwaukee
Paul Van Henkelum, QC RVW, Milwaukee
Drew Diefendorf, QC RVW, Milwaukee
Jean Somers, QC RVW, Reston

CH2M HILL

TECHNICAL MEMORANDUM NO. 3

TO: Karen Vendl
U.S. EPA
CERCLA Enforcement Section

FROM: Al Sloan/CH2M HILL, Milwaukee

PREPARED BY: Dan Plomb/CH2M HILL, Milwaukee

DATE: March 29, 1989

RE: Environmental Conservation and Chemical Corporation Variable Head Hydraulic Conductivity Testing and Analysis

PROJECT: GLO65556.TS.PT

INTRODUCTION

Aquifer tests were conducted on several of the monitoring wells at the Environmental Conservation and Chemical Corporation (ECC) site on October 24 and 25, 1988. Hydraulic conductivity values of the surficial sand and gravel aquifer were measured using variable head (slug) tests. The slug tests were performed to provide information that will be used during the design of a groundwater extraction system, and also in calculations related to groundwater and contaminant velocities. This memorandum describes the test methods, data evaluation procedures, test results and data limitations for the tests performed at the ECC site.

Variable head tests are single well tests used to estimate hydraulic conductivity in the vicinity of the well screen by adding or removing a known volume of water. The rate at which the water level in the well recovers is measured and used to estimate the hydraulic conductivity.

The tests conducted at ECC were "rising" head tests. By applying an artificial head pressure to the well, either in the form of a solid PVC slug or a volume of inert gas under pressure, a known volume of water is then displaced through the well screen back into the aquifer. When the well has fully stabilized from this stress, the slug (of either PVC or gas pressure) is removed, instantaneously lowering the water level. Data were then collected while water levels recovered within the well. Tests were performed by Dan Plomb, Kevin Olson, and Jan Williams of CH2M HILL.

Tests were performed on monitoring wells ECCMW13, 14, 15, 16, 17, 18, 19B, 20, 21, 22, and 23. The wells were screened in the shallow sand and gravel unit beneath the site. Tests were performed on the chosen wells because of their locations in the area of the site where groundwater extraction is being considered. Only monitoring wells that were installed and developed during the most recent, predesign investigation were tested. Locations are shown in Figure TM-3-1. All tests were run in triplicate to improve the confidence in the test results.

VARIABLE HEAD TESTING

METHOD OF TESTING

Two methods were used to displace the static water column in the wells. The preferred method consisted of displacing water from the well using nitrogen gas. This method is preferred because contact between potentially contaminated wellwater and testing equipment and personnel is minimized, and only a single transducer needs to be decontaminated. In addition to health and safety concerns, the method reduces the possibility of cross-contamination of wellwater when test equipment is moved between wells. Use of the nitrogen depression method is limited to wells in which a sufficient volume of water can be displaced from the riser pipe without lowering the water level below the top of the wellscreen. Because nitrogen gas would leak through the screen, it is not physically possible to use this method when the water level is depressed below the screen. The alternative method, using a PVC slug to displace wellwater, was used when the screened interval was close to or straddled the water table.

NITROGEN DEPRESSION METHOD

Equipment

The test assembly used to displace wellwater using the nitrogen depression method is shown in Figure TM-3-2. The wellhead assembly is attached to the top of the riser pipe. A gastight seal between the assembly and riser pipe is then obtained by mechanically expanding a rubber packer at the base of the assembly. The wellhead assembly contains gastight ports for connecting two pressure transducers, a fitting for attaching a pressure regulator, and a vent valve. The pressure transducers are connected to an electronic data logger (Campbell Scientific Model 21X). Transducer No. 1

measures total head, which is the sum of the elevation head and pressure head above the transducer. Transducer No. 2 measures the pressure head resulting from the nitrogen gas. In addition to recording head values at discrete time intervals for later analysis, the data logger is programmed to calculate hydraulic conductivity directly in the field using simplifying assumptions regarding aquifer geometry. Therefore, a quick field check on the validity of the data is possible prior to disassembling the equipment.

Testing Procedure

The test procedure generally consists of the following steps. First, the wellhead assembly and transducer equipment are set up at the well location as shown in Figure TM-3-2. The initial water level (with respect to Transducer No. 1) is recorded prior to pressurizing the system. Pressurized nitrogen is then introduced into the riser pipe. Inasmuch as the units of the data logger readout are in feet of water, the equivalent water height due to the nitrogen pressure head is read directly from Transducer No. 2. The amount of pressure head introduced into the well is such that water will be displaced at least 2 to 3 feet, but not below the top of the screen. Pressure is controlled by regulators in the nitrogen supply line. The pressure head forces water from the riser casing into the surrounding formation. As the water level in the well decreases under a constant pressure head, the total head (Transducer No. 1) decreases. Eventually, total head will return to the initial head value (initial water level), except that now the total head above Transducer No. 1 includes the pressure component from the nitrogen gas. At this point the test is started by opening the vent valve to instantaneously release the pressure head by depressurizing the system and starting the data logger. In effect, this is similar to instantaneously removing a column of water equal to the volume of water displaced by the gas. Water levels are then recorded versus time as the water column recovers.

PVC SLUG METHOD

Equipment

In theory, the PVC slug method is identical to the nitrogen depression method except that a PVC slug is inserted in the well instead of nitrogen gas to displace the water. The PVC slug is solid with a 1/2-inch hole drilled down its center,

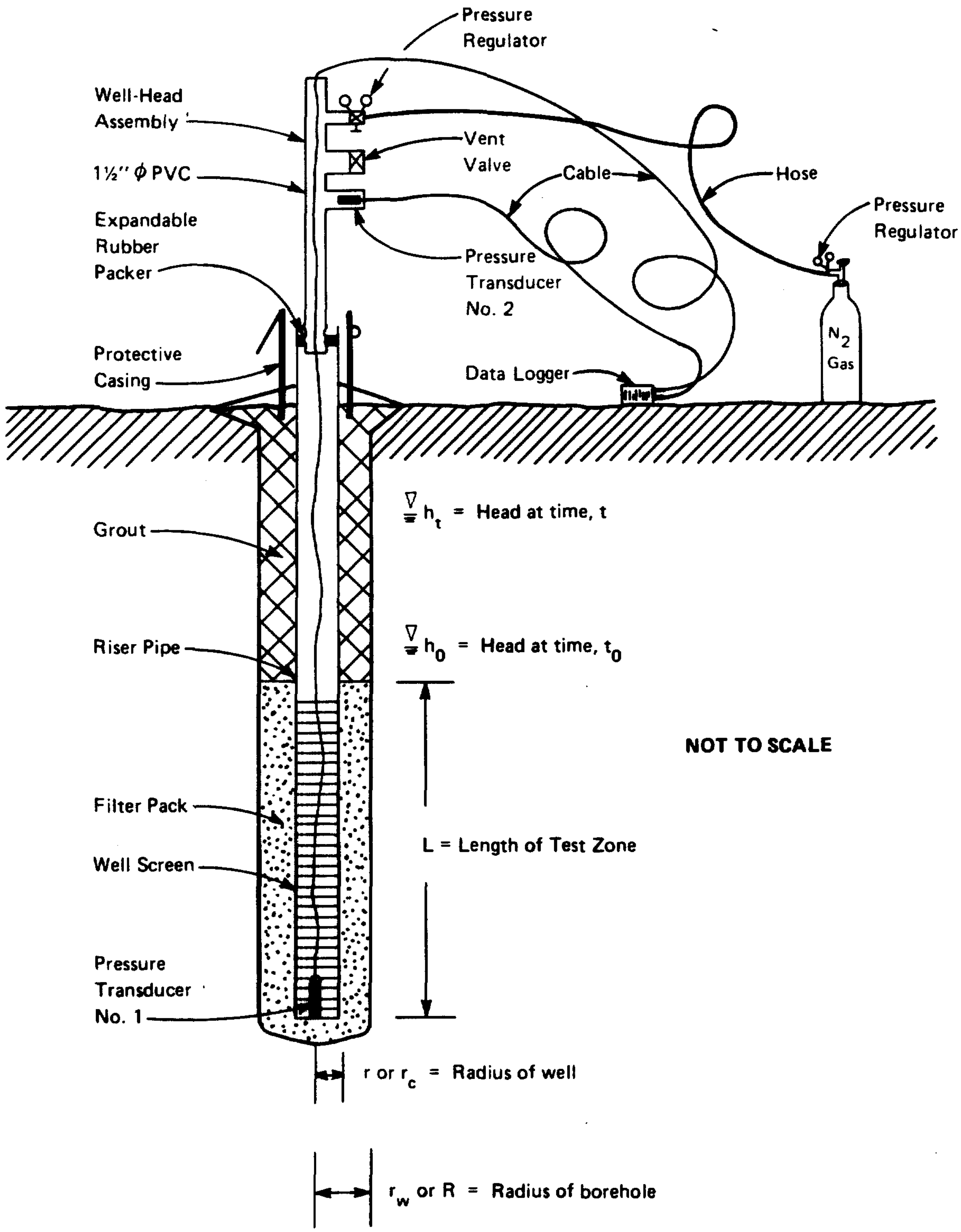

FIGURE TM-3-2
SCHEMATIC DIAGRAM OF NITROGEN SLUG TEST ASSEMBLY
ECC TECHNICAL MEMORANDUM NO. 3

allowing the use of a pressure transducer for measuring and recording water levels. The slug and test apparatus for this method are shown on Figure TM-3-3.

Procedure

The test procedure generally consists of the following steps. First, the well head assembly and transducer equipment are set up at the well location. The test equipment, including the PVC slug is then lowered into the water and the water level within the well is then allowed to stabilize. Once the water level has stabilized, the slug is quickly removed from the well, displacing a known volume from the well. The data logger is then used to record the rate at which the water level within the well recovers.

METHOD OF ANALYSIS

Tests were evaluated using the Bouwer and Rice method. The method was corrected when necessary to adjust the well radius to account for a porosity change associated with the sand pack when the water level is changing within the screened portion of the well. This correction was performed on data obtained from monitoring Well No. ECCMW13, which was the only well with water levels occurring below the top of the screened interval. The following sections describe the test and data reduction methods used at the ECC site.

BOUWER AND RICE METHOD

This method is described by Bouwer and Rice (1976). The equation for estimating hydraulic conductivity is:

$$K = \frac{rc^2 \times \ln(Re/rw) \times \ln(yo/yt)}{2 \times L \times t}$$

where,

K = hydraulic conductivity [L/T]
L = length of test zone [L]
t = time measured from start of test [T]
yo = initial head difference [L]
yt = head difference at time t [L]
rc = well radius, [L] (corrected for porosity in the sand pack)
Re = effective radial distance over which the head (y) is dissipated [L]
rw = radius of the borehole [L]

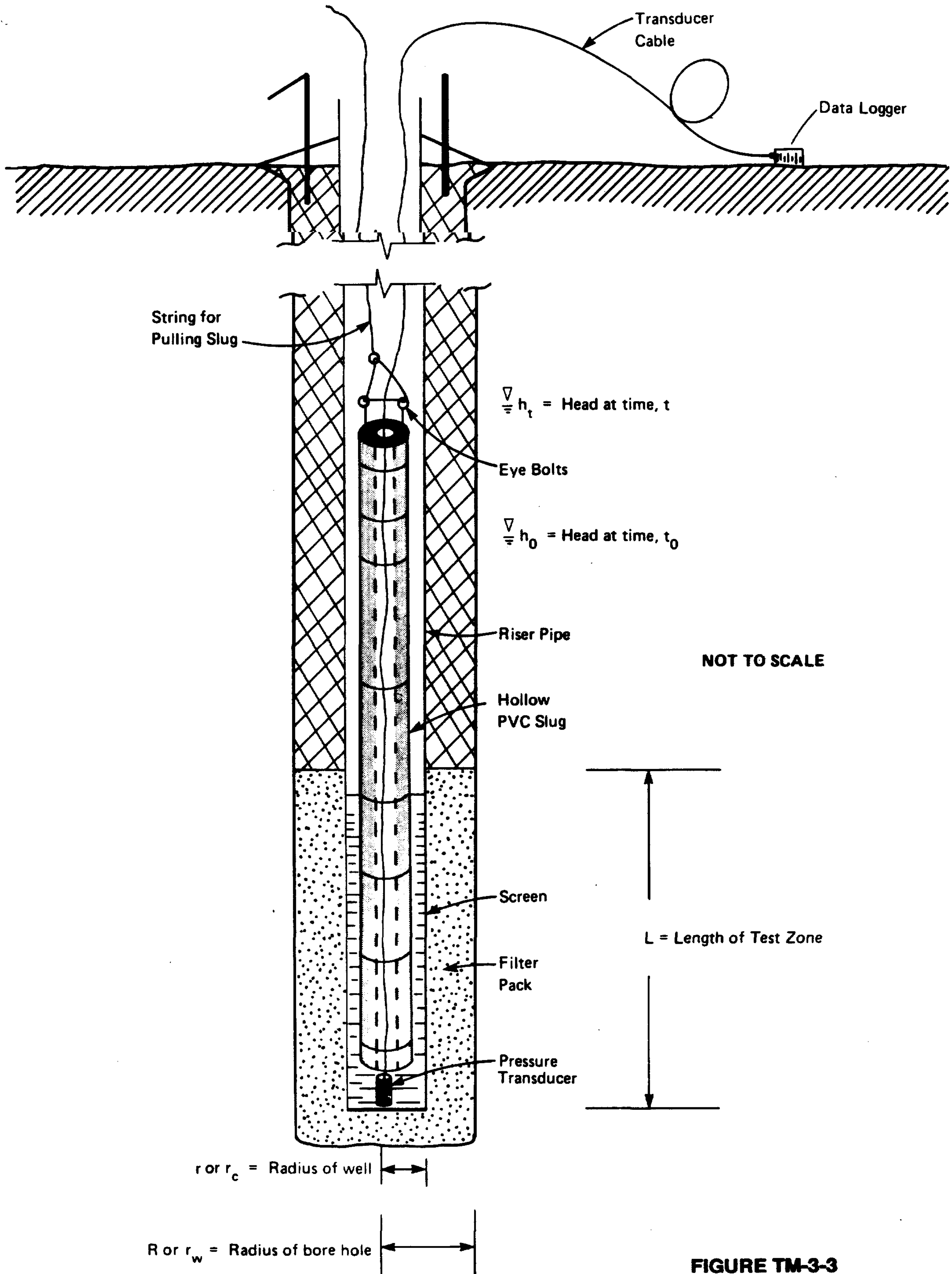

FIGURE TM-3-3
PVC SLUG TEST ASSEMBLY
ECC TECHNICAL MEMORANDUM NO. 3

The value of the term ln (Re/Rw) is determined graphically using several curves for empirical constants given by Bouwer and Rice (1976, p. 426).

RESULTS

Test results of hydraulic conductivities calculated using the Bouwer and Rice method are summarized in Table TM-3-1. Graphical presentations of the test data (feet of water in well versus time) along with determined hydraulic conductivities for this method are presented in Attachment TM-3-1. Raw data and data reduction notes have been retained in the ECC project files. Calculated values of hydraulic conductivity indicate an average range from 2.4×10^{-4} cm/s to 5.5×10^{-2} cm/s. A logarithmic average of the three test values at each well was calculated. A logarithmic average was used because, statistically, hydraulic conductivity values generally show a logarithmic distribution versus a normal distribution.

Data Limitations

The following assumptions are inherent in the theoretical development of the Bouwer and Rice equations for analyzing slug test data:

- Drawdown of the water table around the well is negligible.
- Flow in the unsaturated zone can be ignored.
- Well losses are negligible.
- The aquifer is homogeneous and isotropic.

Assumptions 1, 2, and 3 are probably satisfied at the ECC site. Assumption 4, however, is satisfied neither locally nor site-wide. Because of this, each test individually is actually an average of the formation material in the immediate vicinity of each test location.

Additional limitations in performing variable head tests apply to Well No. ECCMW13, which was the only well with the water level occurring below the top of the screened interval. An assumption in the analysis is that the recovery is limited to within the well casing. Because the recovery in this instance takes place within the screened interval and the filter pack, the volume recovered per foot in the well is greater than that of the assumed well casing by the volume of the porosity of the filter pack. By correcting the volume of the well casing to incorporate both the volume of the screen (which is equal to that of the casing) and the porosity of the filter pack, the standard analysis can then be applied. As the well recovers, the effective screen length and the effective thickness of the aquifer change. These were not accounted for, nor do any corrections or methods of analyses exist in which they are accounted for. For this reason, the rising head data obtained from the wells in which the water table surface occurs below the top of the screened interval are less accurate than data obtained from wells in which the screened interval is entirely submerged.

CONCLUSIONS

An average hydraulic conductivity of 1×10^{-2} cm/s was assumed for the sand and gravel unit during feasibility study calculations. The assumed value falls within the range of values determined using slug testing on individual wells (2.4×10^{-4} cm/s to 5.5×10^{-2} cm/s). However, some of the determined values are almost two orders of magnitude lower than the previously assumed values. The hydraulic conductivity in the unit probably varies across the determined range within the unit. The range of hydraulic conductivity values should be considered for future estimations of groundwater pumping/collection from this unit.

REFERENCES

Bouwer, Herman, and R. C. Rice. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. Water Resources Research. 12 (1976): 423-28.

GLT869/3

Table TM-3-1
RESULTS OF VARIABLE HEAD TESTING

Well I.D.	Test 1 (cm/s)	Test 2 (cm/s)	Test 3 (cm/s)	Log Average (cm/s)
ECCMW13	6.1×10^{-3}	7.9×10^{-3}	6.7×10^{-3}	6.9×10^{-3}
ECCMW14	5.4×10^{-2}	5.6×10^{-2}	5.6×10^{-2}	5.5×10^{-2}
ECCMW15	3.5×10^{-2}	3.2×10^{-2}	3.0×10^{-2}	3.2×10^{-2}
ECCMW16	6.3×10^{-3}	6.8×10^{-3}	6.9×10^{-3}	6.7×10^{-3}
ECCMW17	3.9×10^{-3}	9.2×10^{-3}	9.3×10^{-3}	9.1×10^{-3}
ECCMW18	1.1×10^{-2}	8.9×10^{-3}	8.5×10^{-3}	9.4×10^{-3}
ECCMW19B	2.5×10^{-4}	2.5×10^{-4}	3.0×10^{-4}	2.7×10^{-4}
ECCMW20	3.7×10^{-3}	3.2×10^{-3}	2.1×10^{-3}	2.9×10^{-3}
ECCMW21	4.1×10^{-2}	1.7×10^{-2}	1.5×10^{-2}	2.2×10^{-2}
ECCMW22	3.6×10^{-2}	2.8×10^{-3}	2.6×10^{-3}	2.9×10^{-3}
ECCMW23	3.0×10^{-4}	1.9×10^{-4}	2.5×10^{-4}	2.4×10^{-4}

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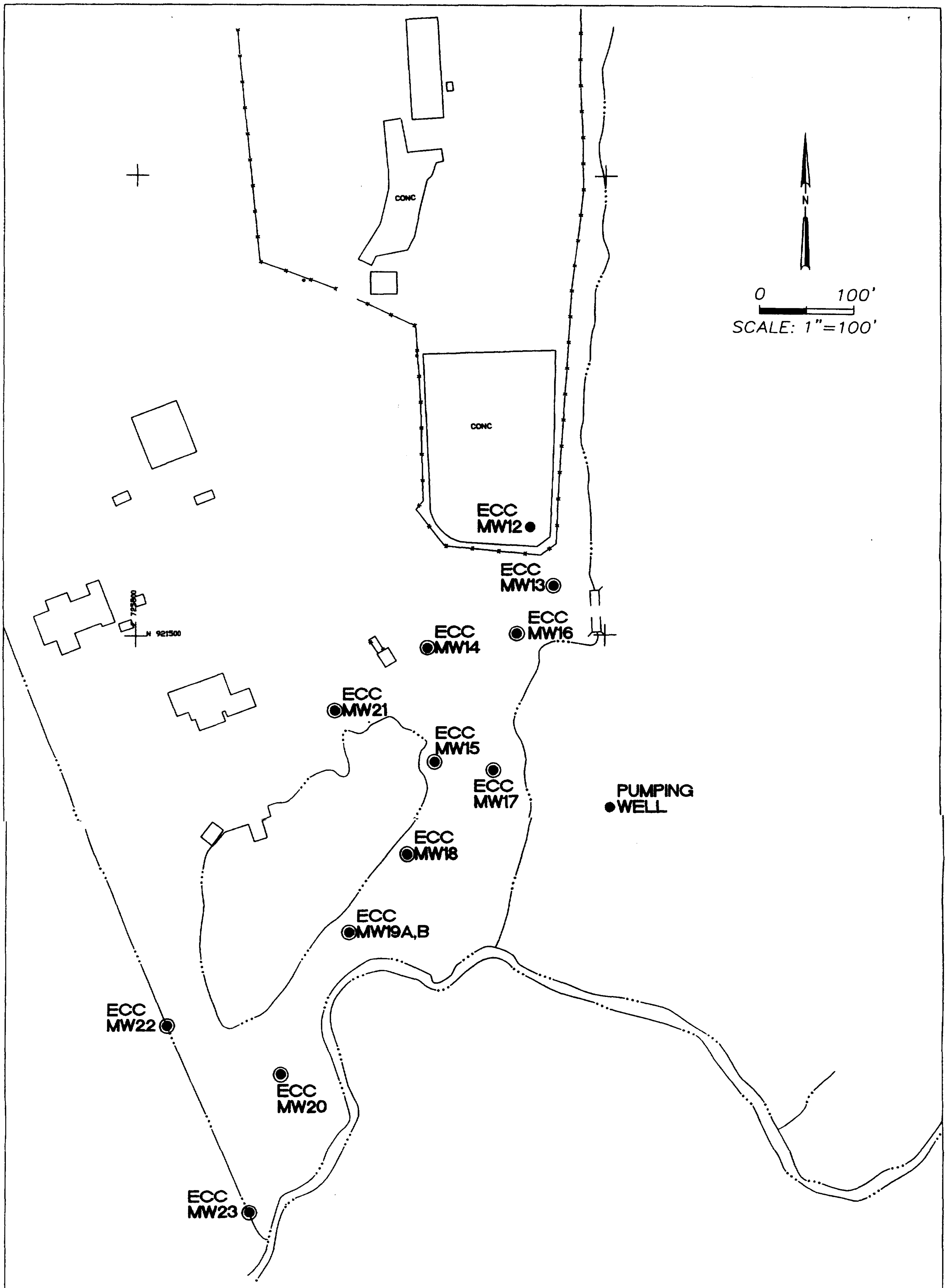


LEGEND

● ECC MW18 WELLS INSTALLED DURING SUPPLEMENTAL INVESTIGATION

◉ ECC MW23 WELLS INCLUDED DURING HYDRAULIC CONDUCTIVITY TESTING

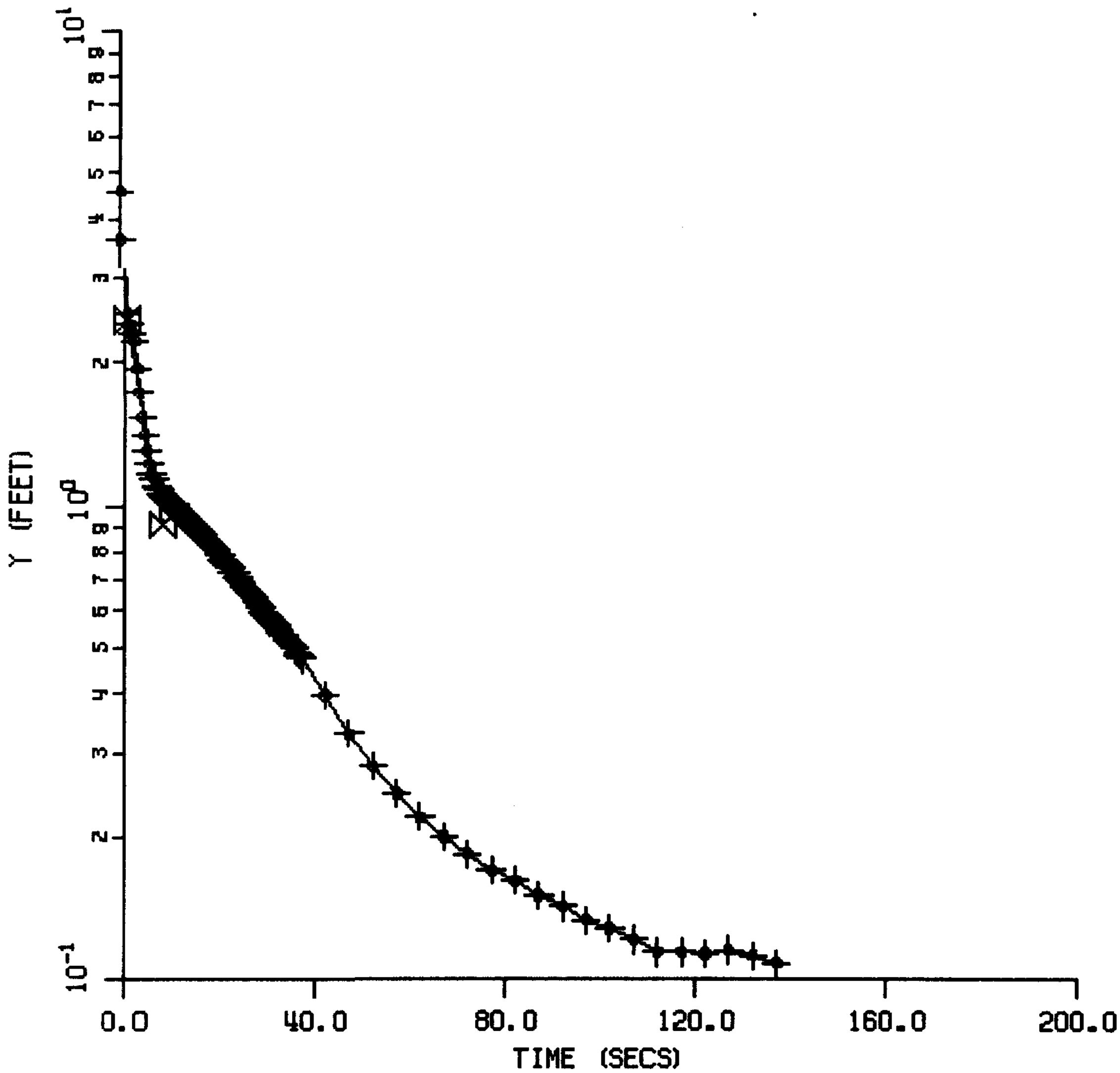
FIGURE TM-3-1
SUPPLEMENTAL INVESTIGATION AREA (ECC)
MONITORING WELL LOCATIONS
ECC TECHNICAL MEMORANDUM NO. 3

CH2M HILL

L65555.TS\FIG3-1 3/24/89

Attachment TM3-1
GRAPHICAL PRESENTATIONS
OF TEST DATA

NSL/ECC
ECCMW13 TEST 1



K (CM/S) = 0.006162

WELL SPECS. (FEET)

SCREEN LENGTH = 8.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 8.0

COEFFICIENTS

A = 0.0

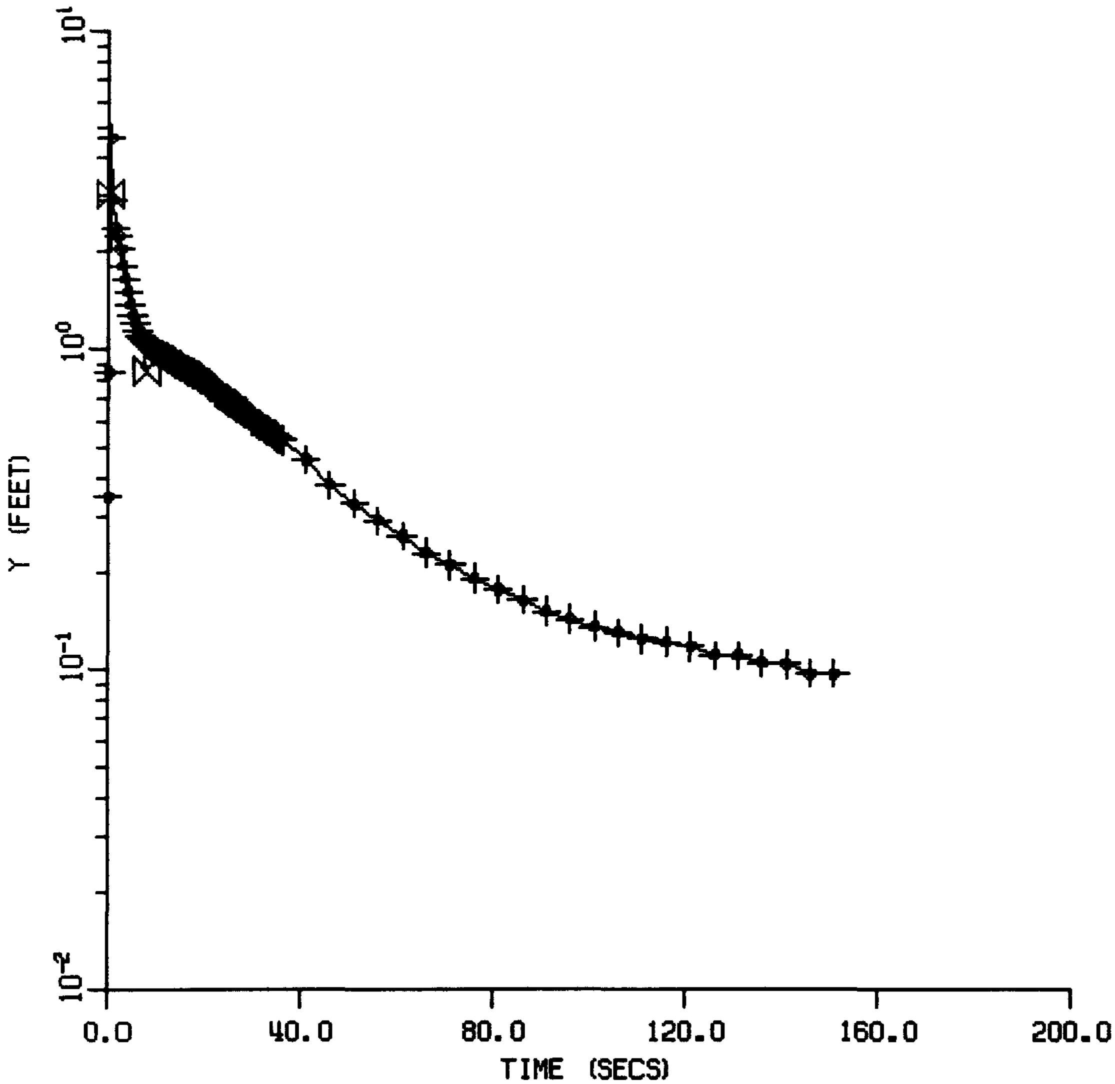
B = 0.0

C = 4.0

Y-INTERCEPT = 2.6

SLOPE = -0.1

NSL/ECC
ECCMW13 TEST 2



K (CM/S) = 0.007947

WELL SPECS. (FEET)

SCREEN LENGTH = 8.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 8.0

COEFFICIENTS

A = 0.0

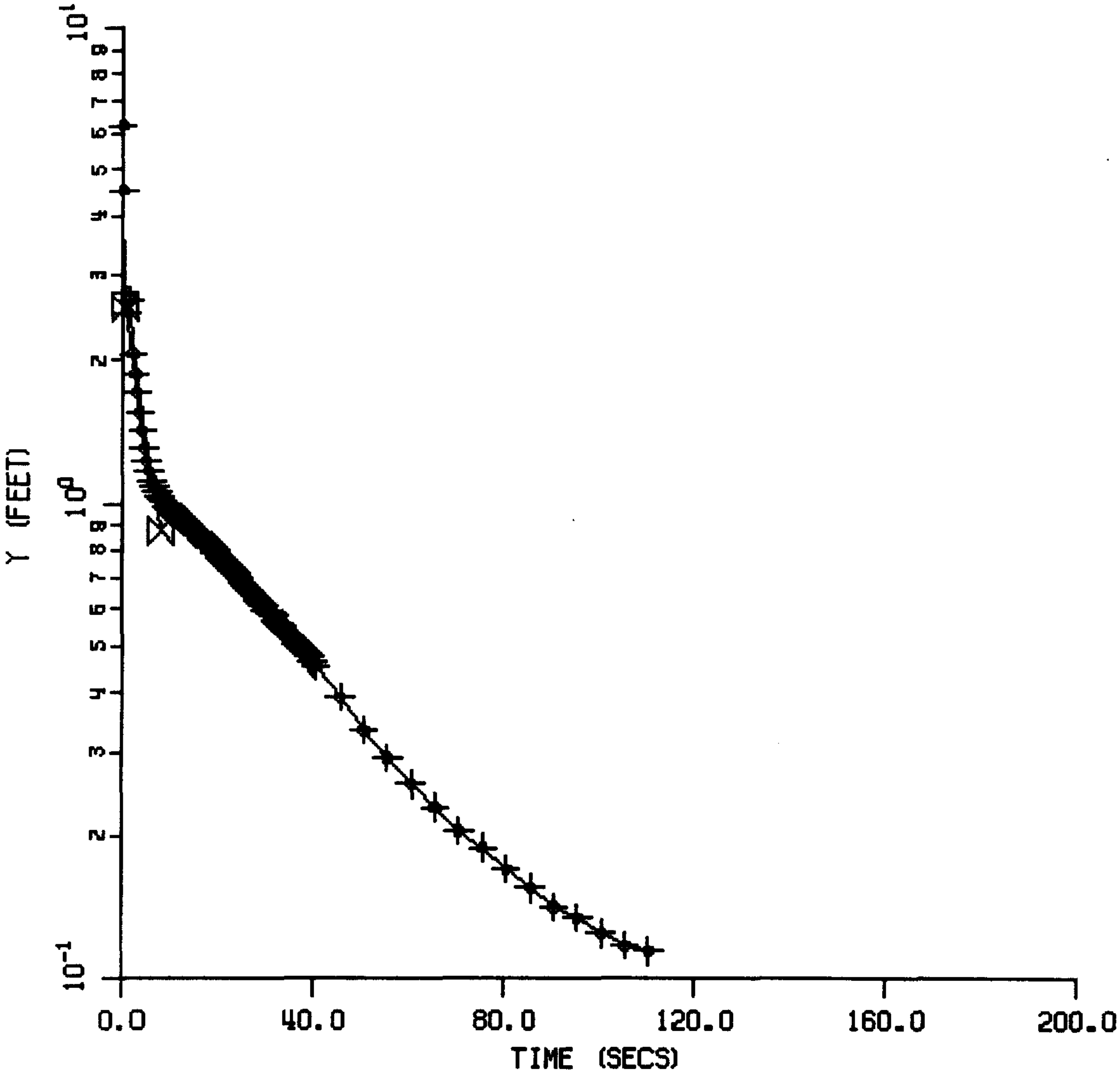
B = 0.0

C = 4.0

Y-INTERCEPT = 3.3

SLOPE = -0.1

NSL/ECC
ECCMW13 TEST 3



K (CM/S) = 0.006710

WELL SPECS. (FEET)

SCREEN LENGTH = 8.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 8.0

COEFFICIENTS

A = 0.0

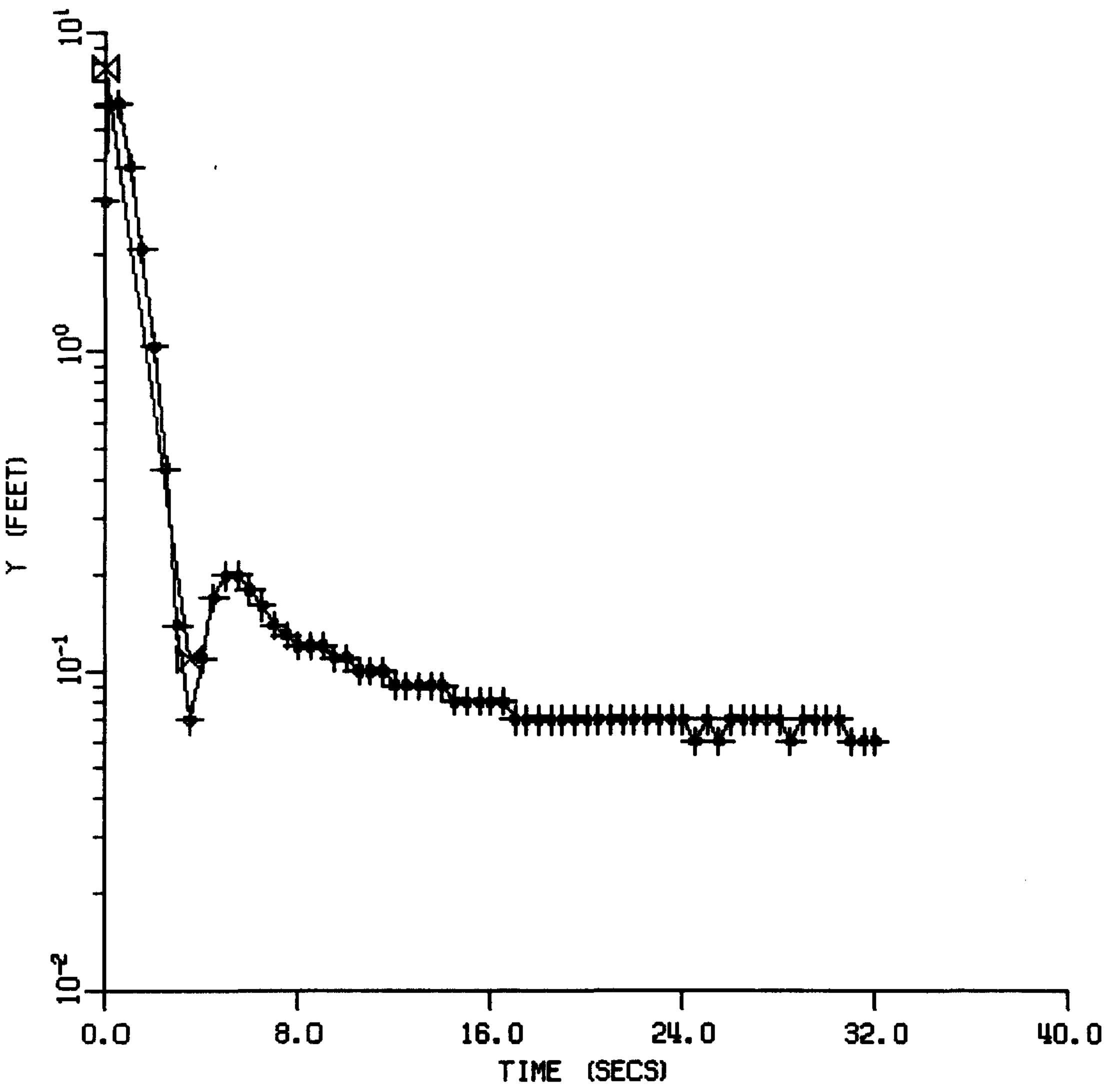
B = 0.0

C = 4.0

Y-INTERCEPT = 2.8

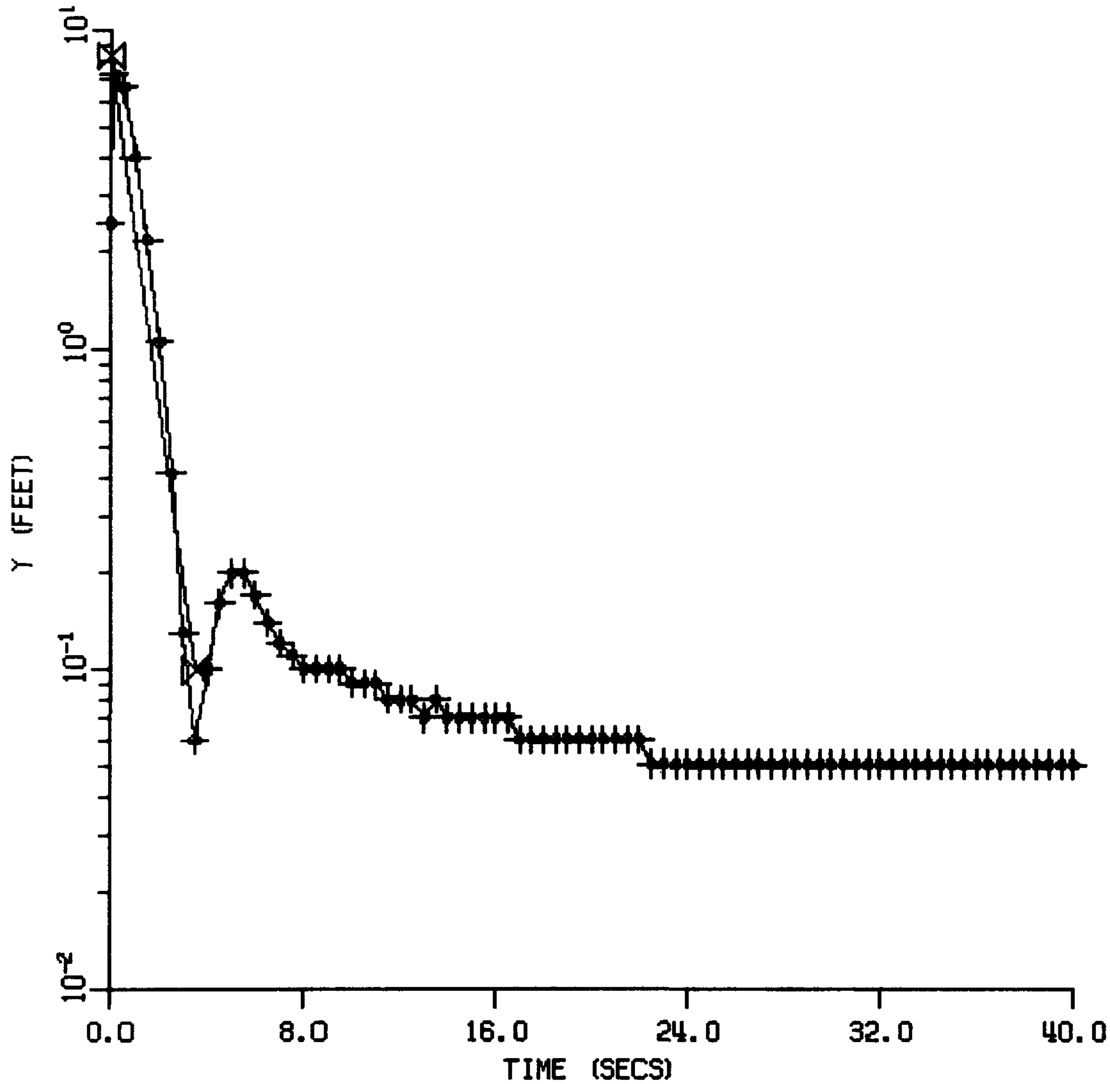
SLOPE = -0.1

NSL/ECC
ECCMW14 TEST 1



K (CM/S) = 0.054355	COEFFICIENTS
WELL SPECS. (FEET)	A = 0.0
SCREEN LENGTH = 10.0	B = 0.0
WELL SCREEN/BORE RADIUS = 0.1	C = 4.7
WELL CASING RADIUS = 0.1	Y-INTERCEPT = 7.8
AQUIFER THICKNESS = 14.0	SLOPE = -0.5

NSL/ECC
ECCMW14 TEST 2



K (CM/S) = 0.056491

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 14.0

COEFFICIENTS

A = 0.0

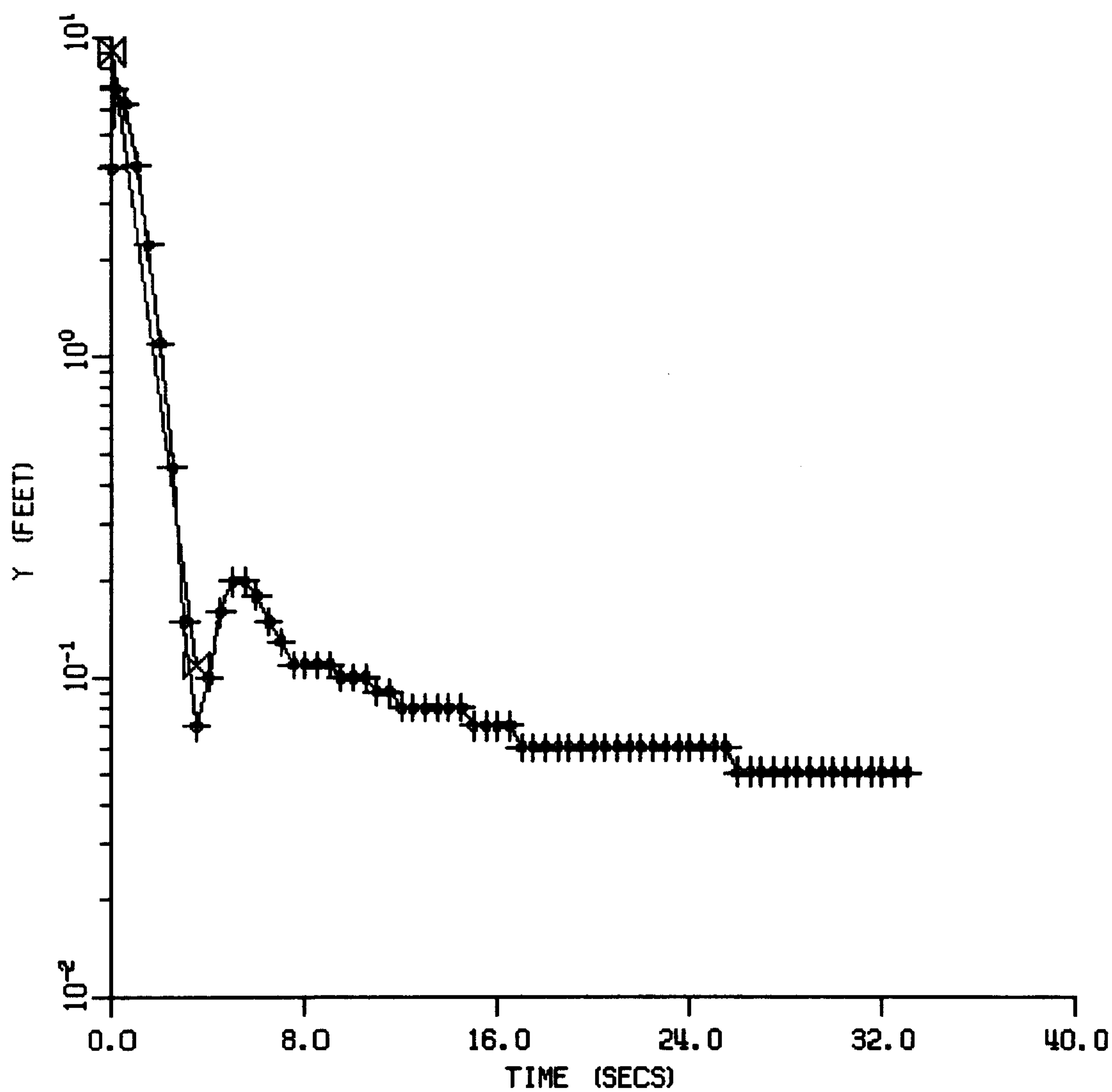
B = 0.0

C = 4.7

Y-INTERCEPT = 8.3

SLOPE = -0.5

ECC/NSL
ECCMW14 TEST 3



K (CM/S) = 0.056331

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 14.0

COEFFICIENTS

A = 0.0

B = 0.0

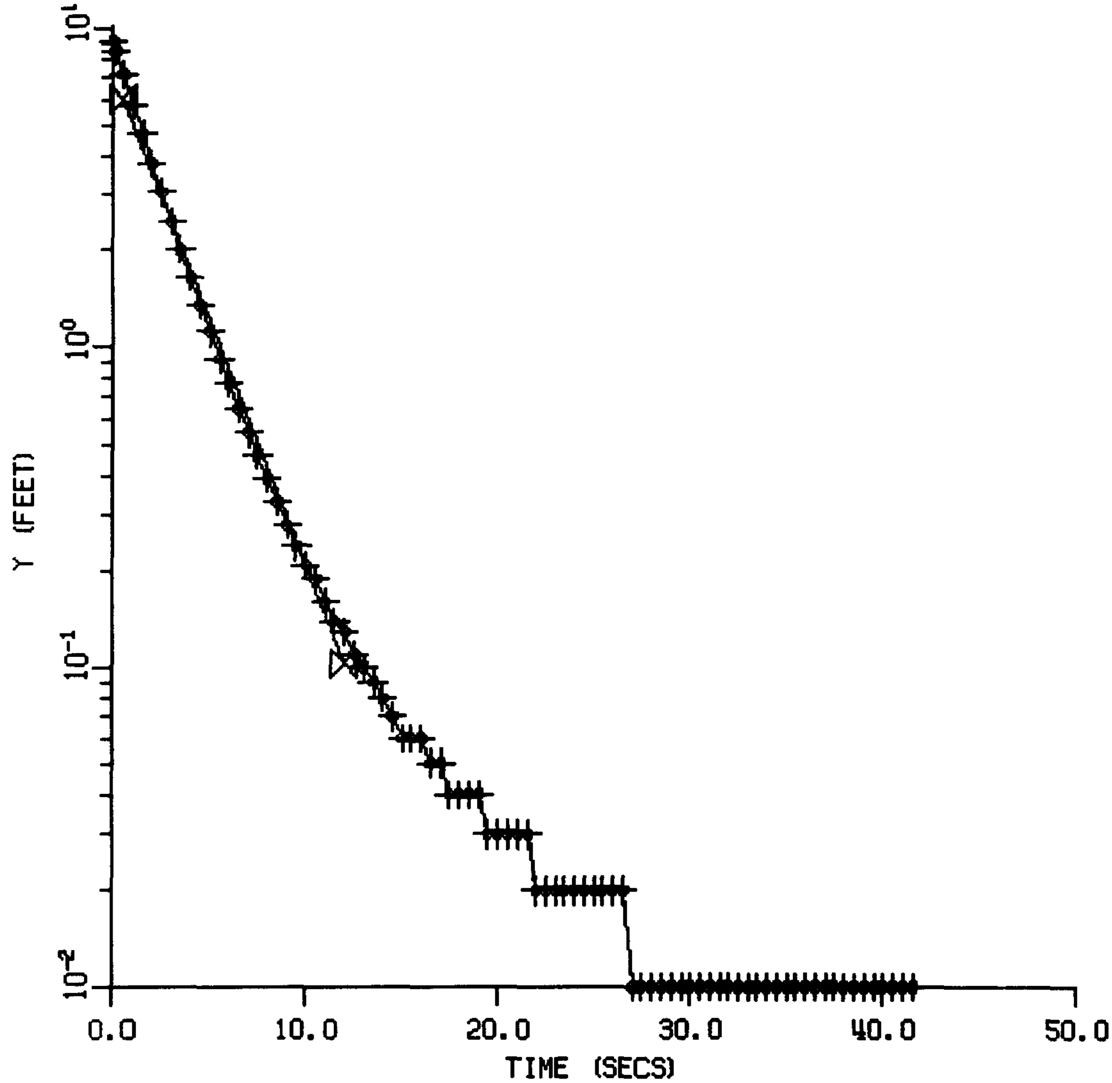
C = 4.7

Y-INTERCEPT = 9.1

SLOPE = -0.5

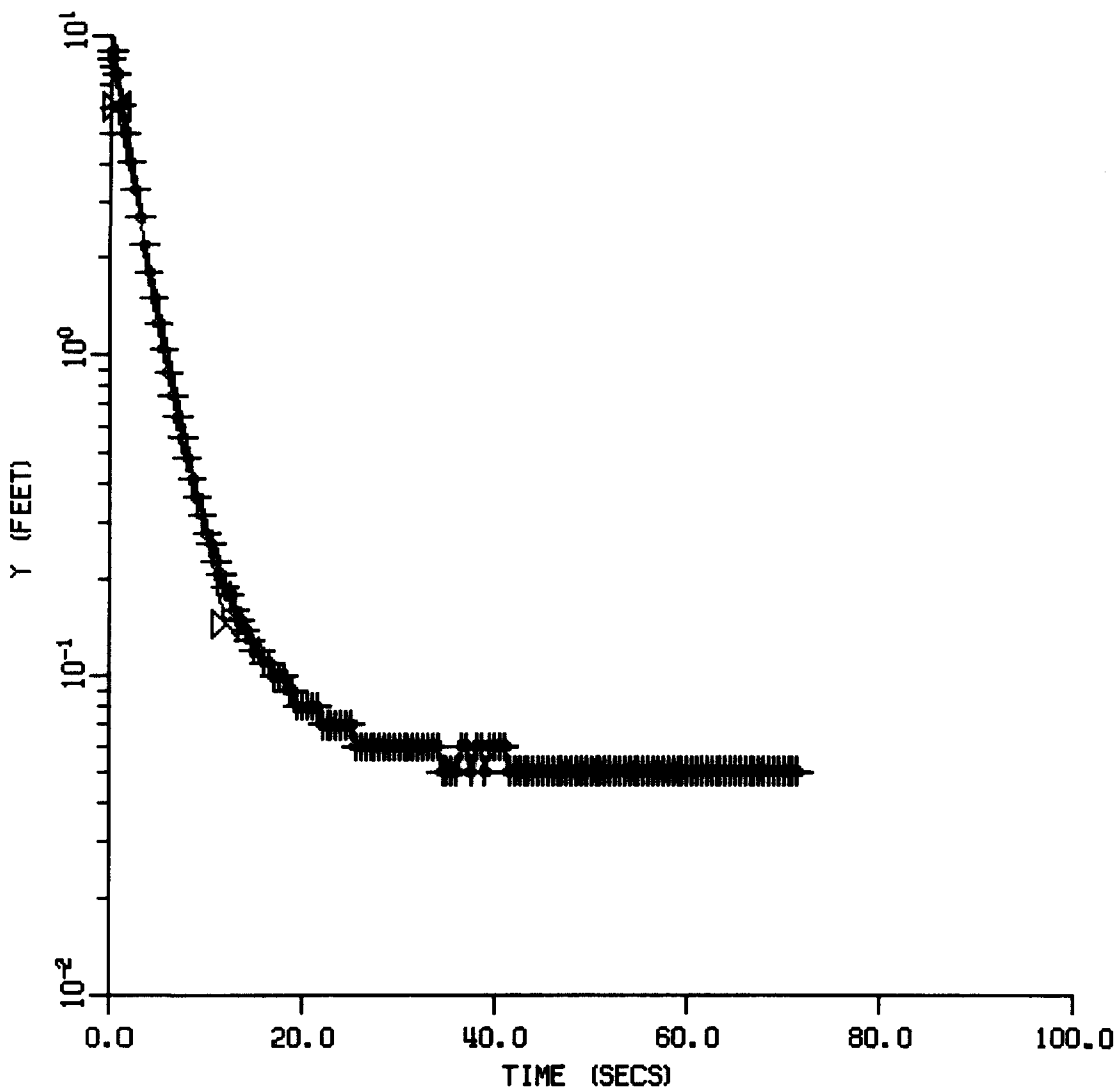
NSL/ECC

ECCMW15 TEST 1



K (CM/S) = 0.035543	COEFFICIENTS
WELL SPECS. (FEET)	A = 0.0
SCREEN LENGTH = 4.0	B = 0.0
WELL SCREEN/BORE RADIUS = 0.1	C = 2.6
WELL CASING RADIUS = 0.1	Y-INTERCEPT = 7.2
AQUIFER THICKNESS = 4.0	SLOPE = -0.2

NSL/ECC
ECCMW15 NSL/ECC



K (CM/S) = 0.032489

WELL SPECS. (FEET)

SCREEN LENGTH = 4.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 4.0

COEFFICIENTS

A = 0.0

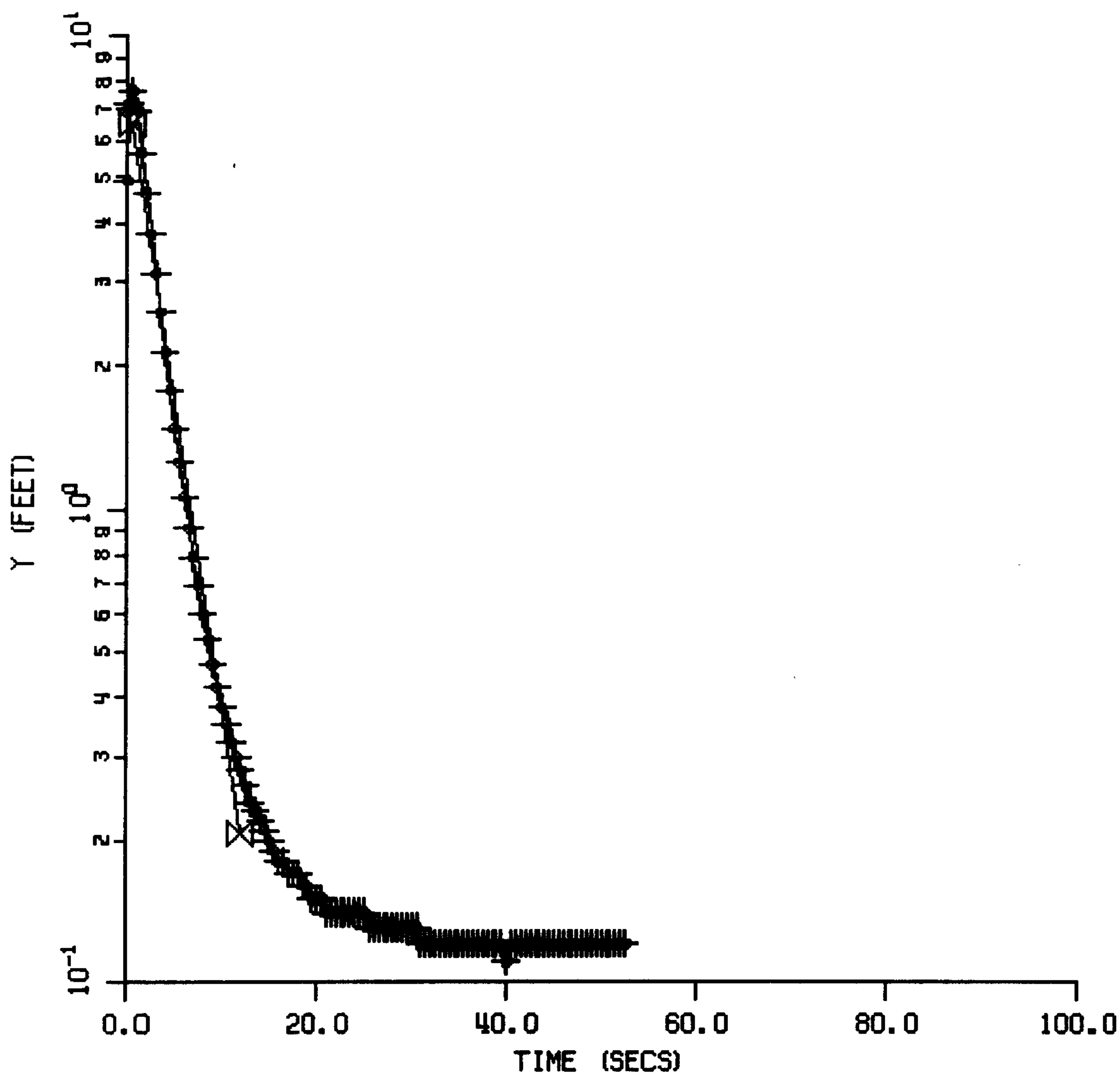
B = 0.0

C = 2.6

Y-INTERCEPT = 7.1

SLOPE = -0.1

NSL/ECC
ECCMW15 TEST 3



K (CM/S) = 0.030135

WELL SPECS. (FEET)

SCREEN LENGTH = 4.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 4.0

COEFFICIENTS

A = 0.0

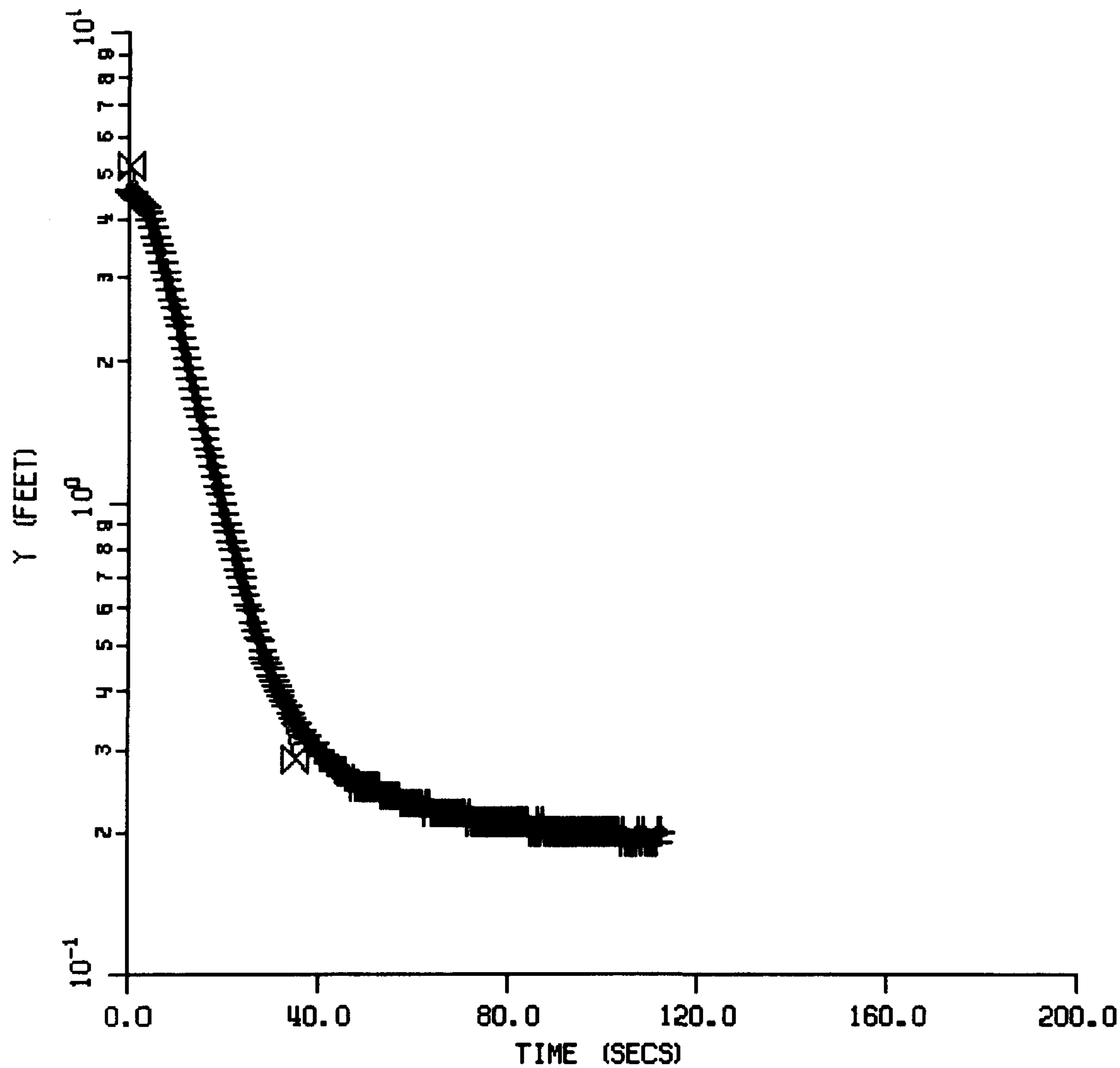
B = 0.0

C = 2.6

Y-INTERCEPT = 7.6

SLOPE = -0.1

NSL/ECC
ECCMW16 TEST 1



K (CM/S) = 0.006250

WELL SPECS. (FEET)

SCREEN LENGTH = 5.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 6.0

COEFFICIENTS

A = 0.0

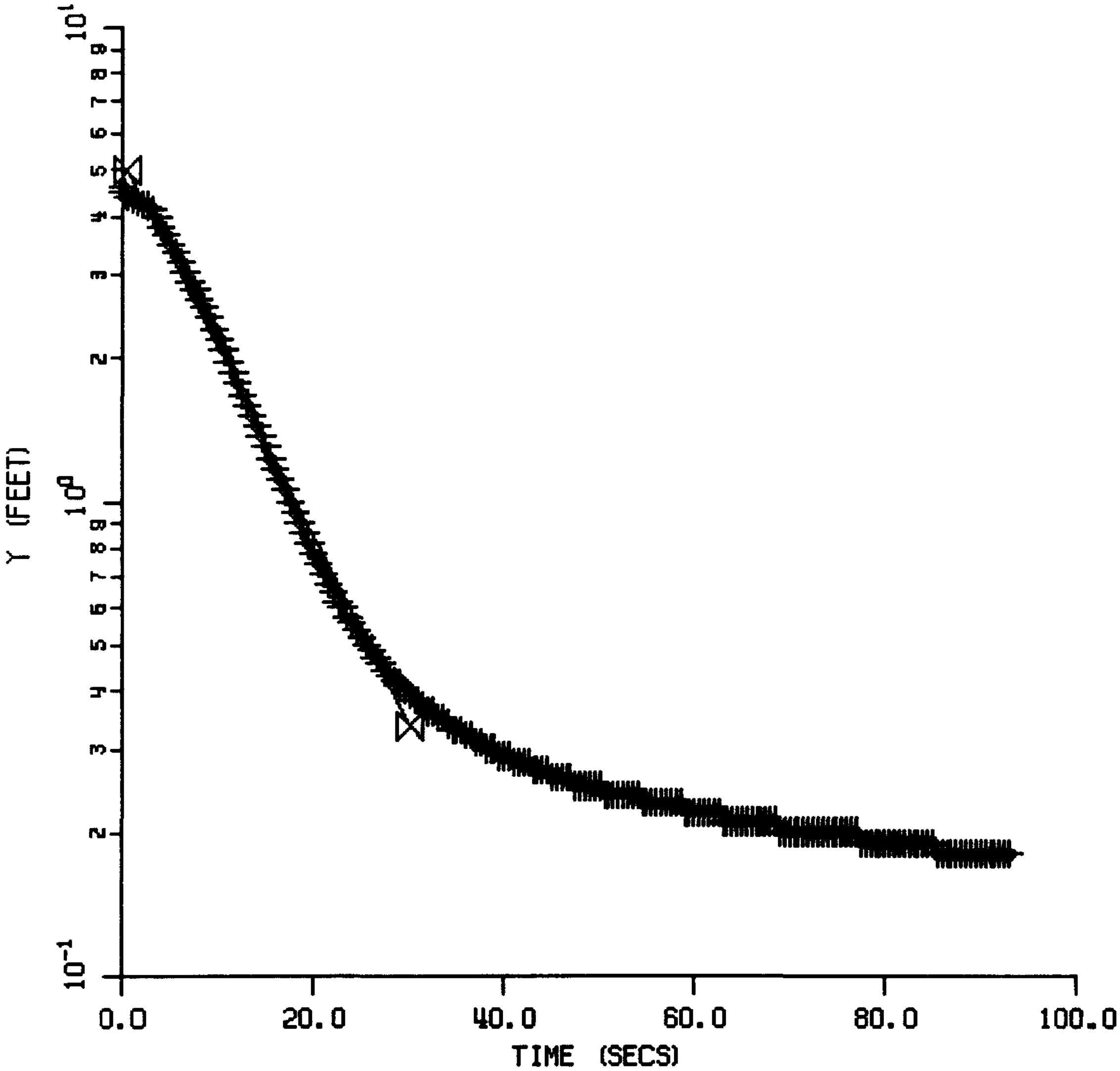
B = 0.0

C = 2.9

Y-INTERCEPT = 5.4

SLOPE = -0.0

NSL/ECC
ECCMW16 TEST 2



K (CM/S) = 0.006806

WELL SPECS. (FEET)

SCREEN LENGTH = 5.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 6.0

COEFFICIENTS

A = 0.0

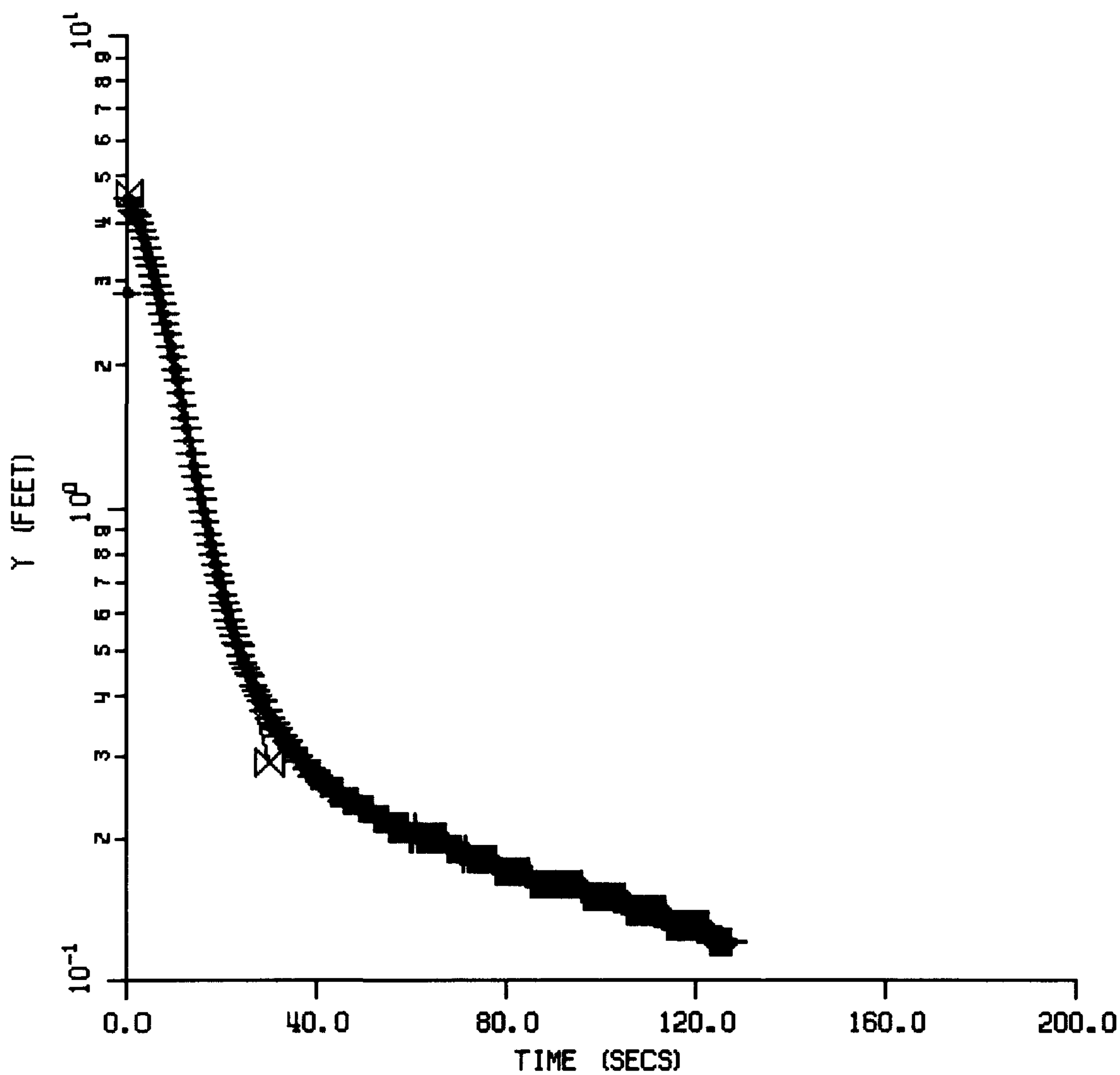
B = 0.0

C = 2.9

Y-INTERCEPT = 5.2

SLOPE = -0.0

NSL/ECC
ECCMW16 TEST 3



K (CM/S) = 0.006979

WELL SPECS. (FEET)

SCREEN LENGTH = 5.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 6.0

COEFFICIENTS

A = 0.0

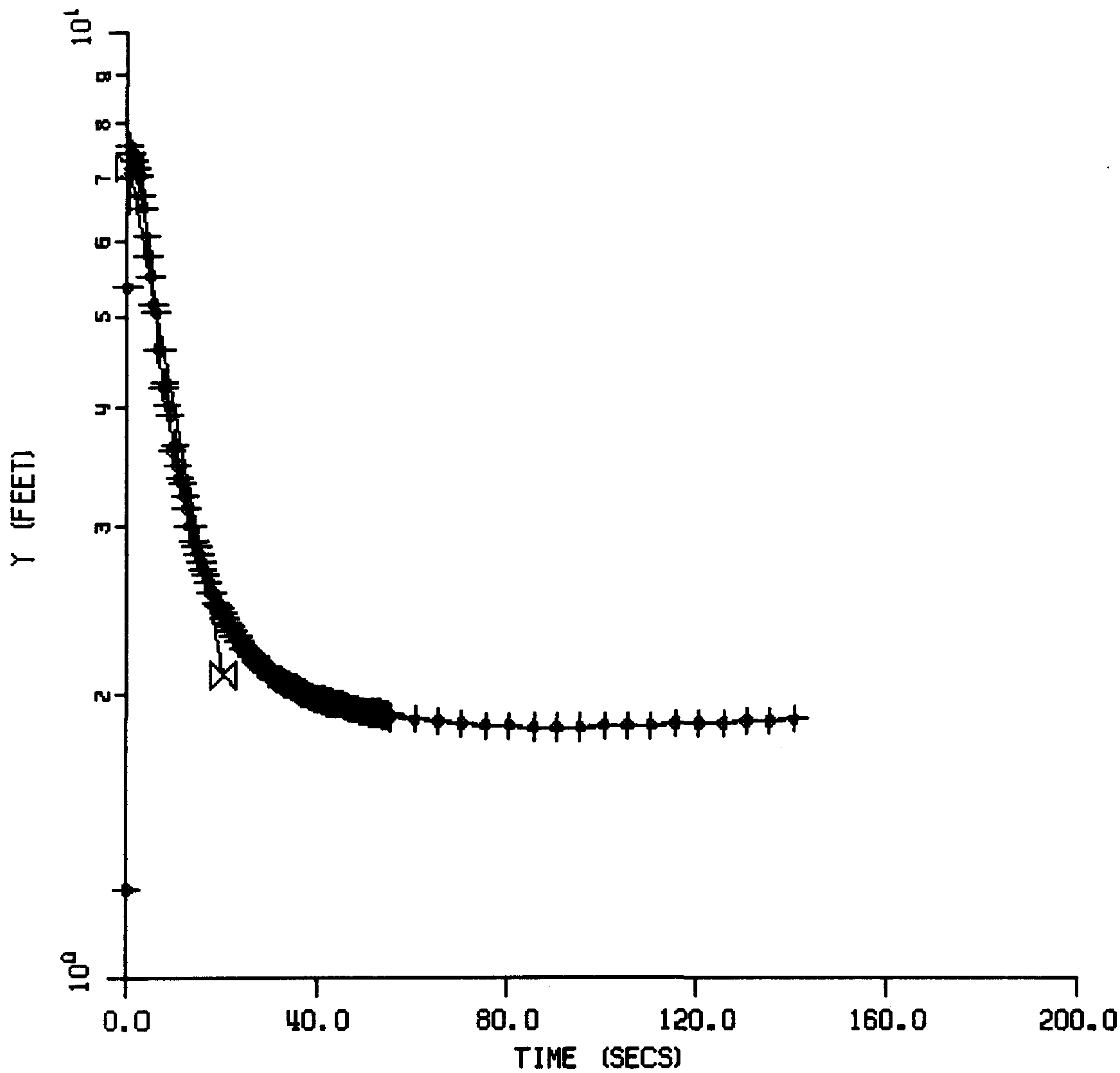
B = 0.0

C = 2.9

Y-INTERCEPT = 4.8

SLOPE = -0.0

NSL/ECC
ECCMW17 TEST 1



K (CM/S) = 0.003929

WELL SPECS. (FEET)

SCREEN LENGTH = 4.0

WELL SCREEN/BORE RADIUS = 0.3

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 4.0

COEFFICIENTS

A = 0.0

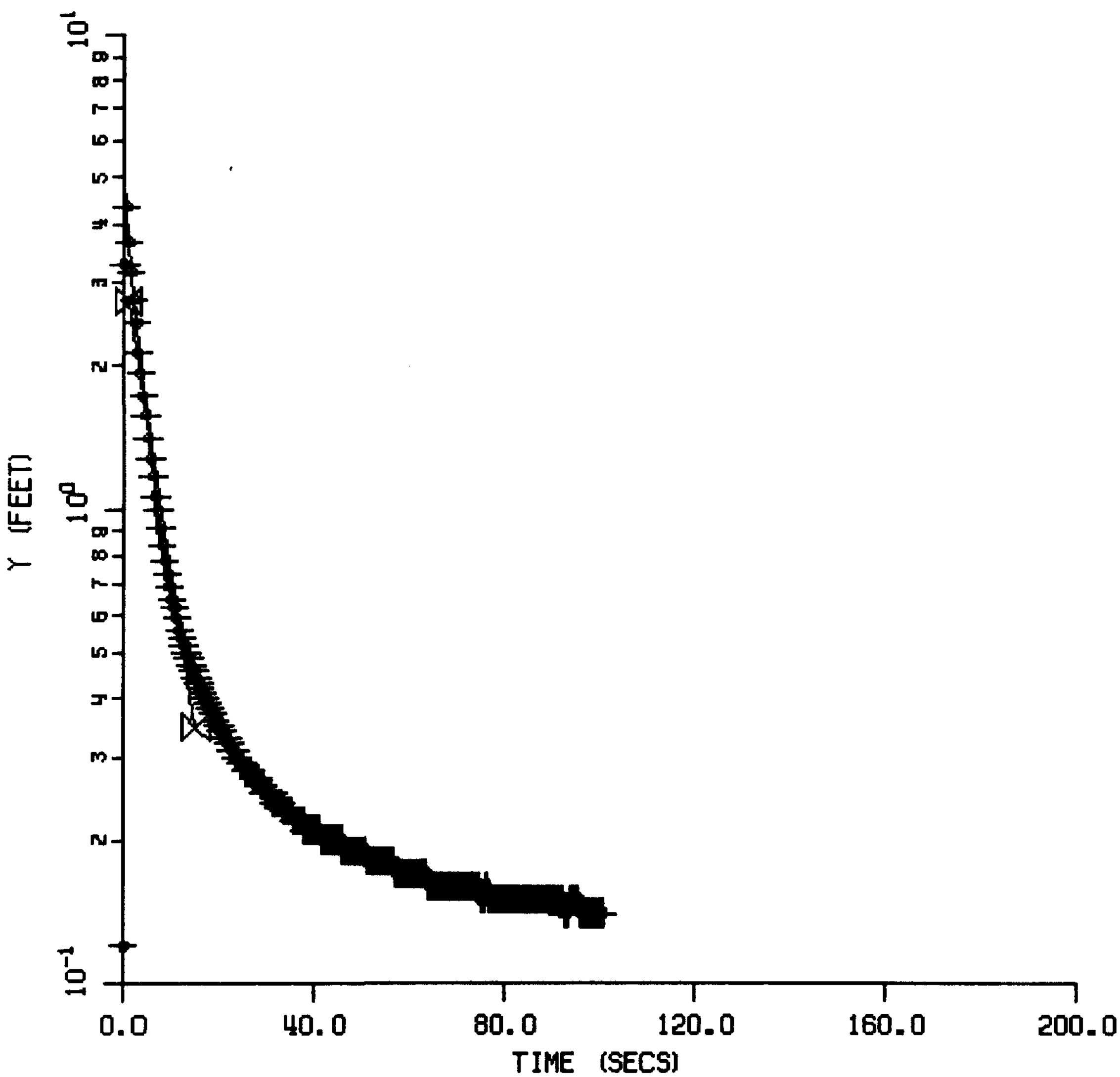
B = 0.0

C = 1.3

Y-INTERCEPT = 7.4

SLOPE = -0.0

NSL/ECC
ECCMW17 TEST 2



K (CM/S) = 0.009152

WELL SPECS. (FEET)

SCREEN LENGTH = 4.0

WELL SCREEN/BORE RADIUS = 0.3

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 4.0

COEFFICIENTS

A = 0.0

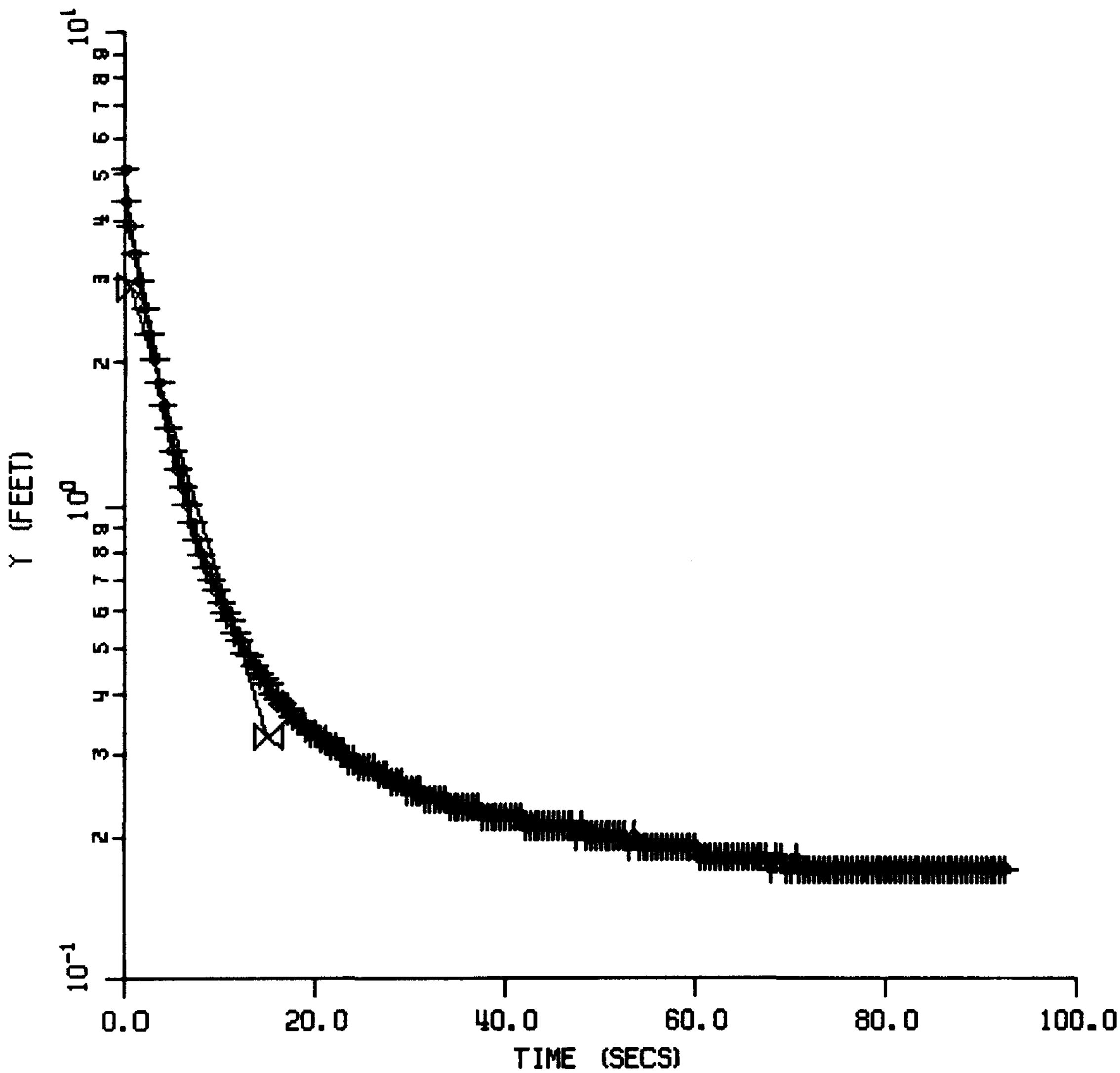
B = 0.0

C = 1.3

Y-INTERCEPT = 3.2

SLOPE = -0.1

NSL/ECC
ECCMW17 TEST 3



K (CM/S) = 0.009336

WELL SPECS. (FEET)

SCREEN LENGTH = 4.0

WELL SCREEN/BORE RADIUS = 0.3

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 4.0

COEFFICIENTS

A = 0.0

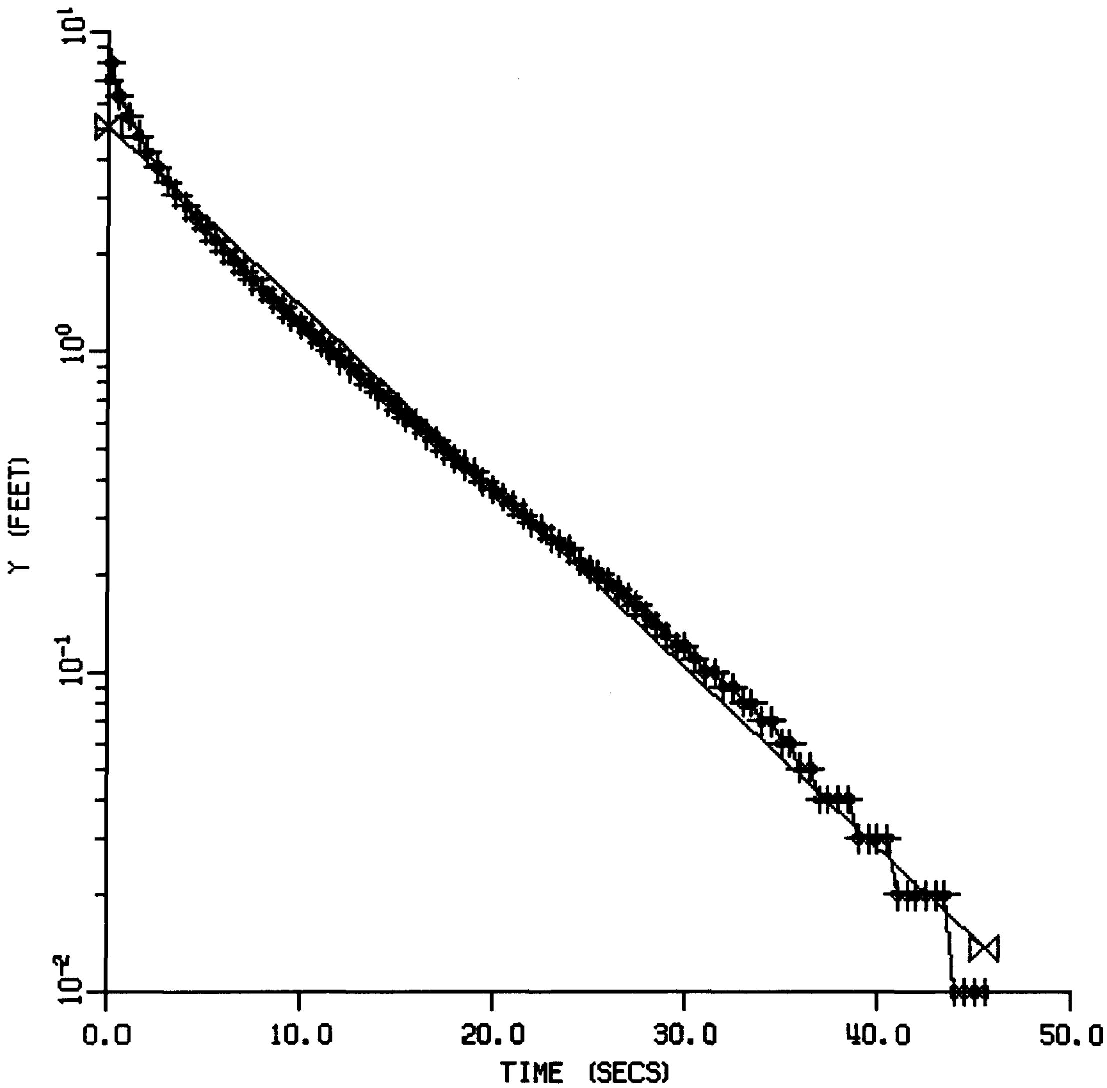
B = 0.0

C = 1.3

Y-INTERCEPT = 3.1

SLOPE = -0.1

NSL/ECC
ECCMW18 TEST 1



K (CM/S) = 0.010601

WELL SPECS. (FEET)

SCREEN LENGTH = 5.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 7.0

COEFFICIENTS

A = 0.0

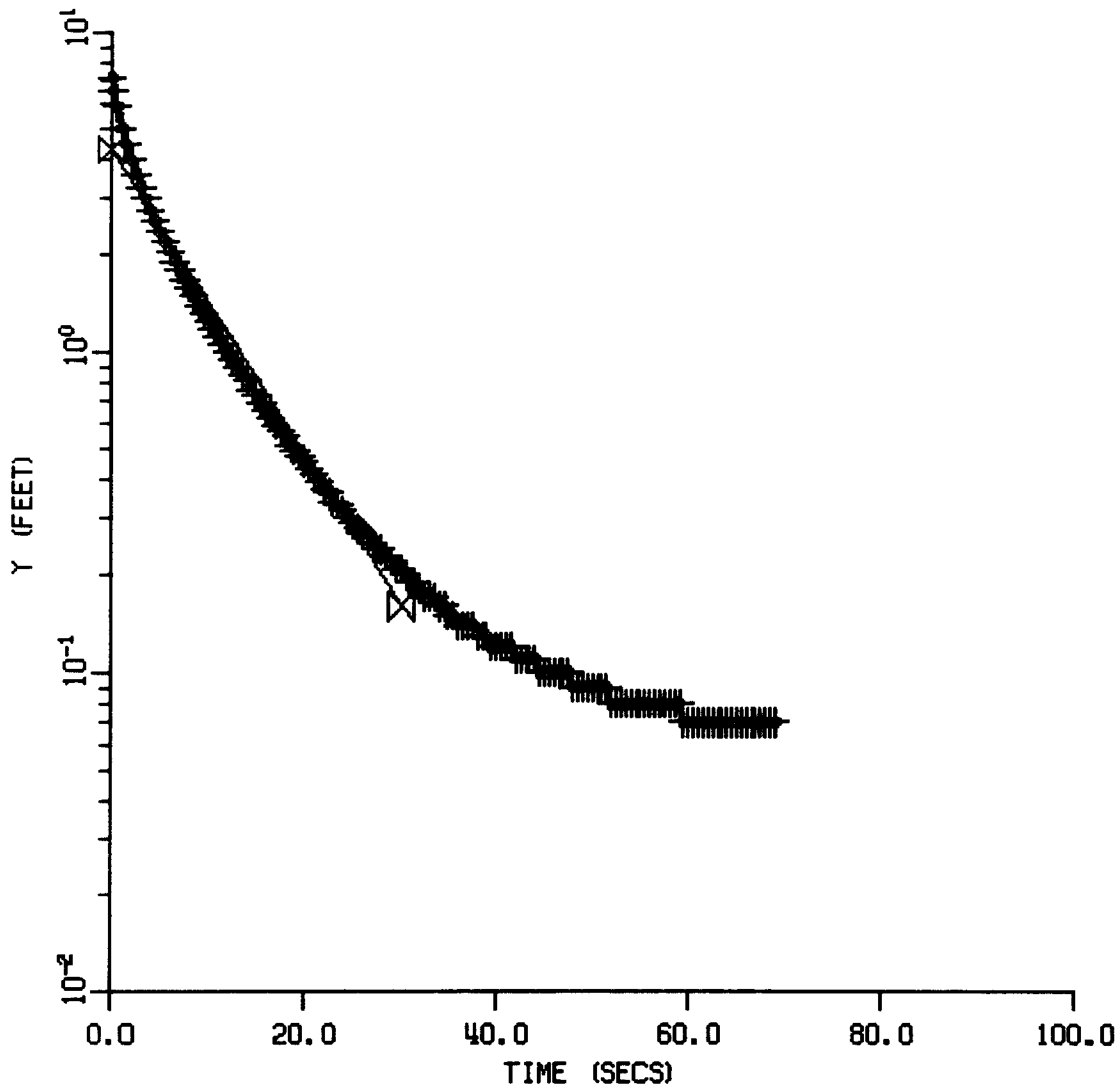
B = 0.0

C = 2.9

Y-INTERCEPT = 5.1

SLOPE = -0.1

NSL/ECC
ECCMW18 TEST 2



K (CM/S) = 0.008935

WELL SPECS. (FEET)

SCREEN LENGTH = 5.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 7.0

COEFFICIENTS

A = 0.0

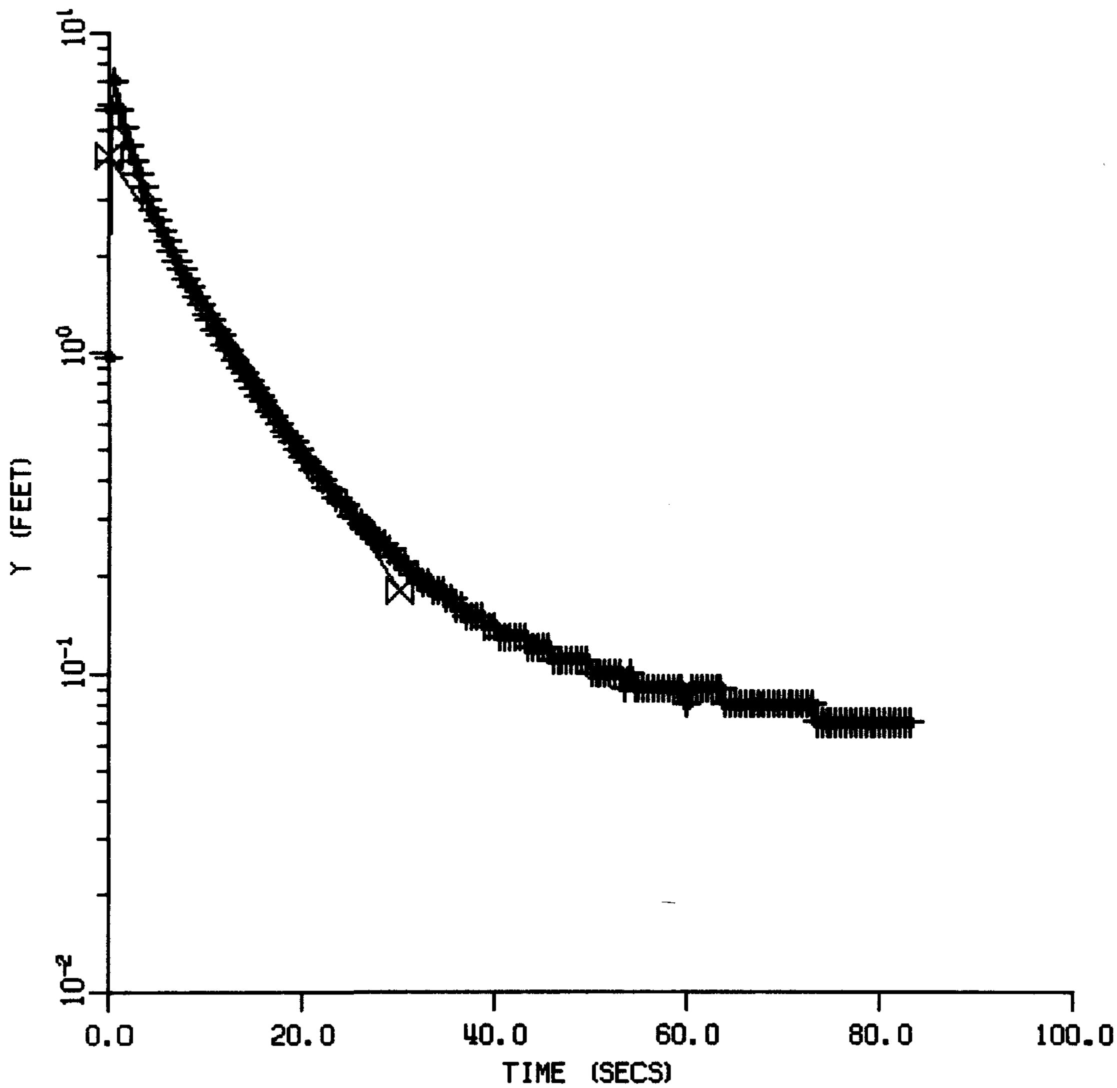
B = 0.0

C = 2.9

Y-INTERCEPT = 4.3

SLOPE = -0.0

NSL/ECC
ECCMW18 TEST 3



K (CM/S) = 0.008494

WELL SPECS. (FEET)

SCREEN LENGTH = 5.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 7.0

COEFFICIENTS

A = 0.0

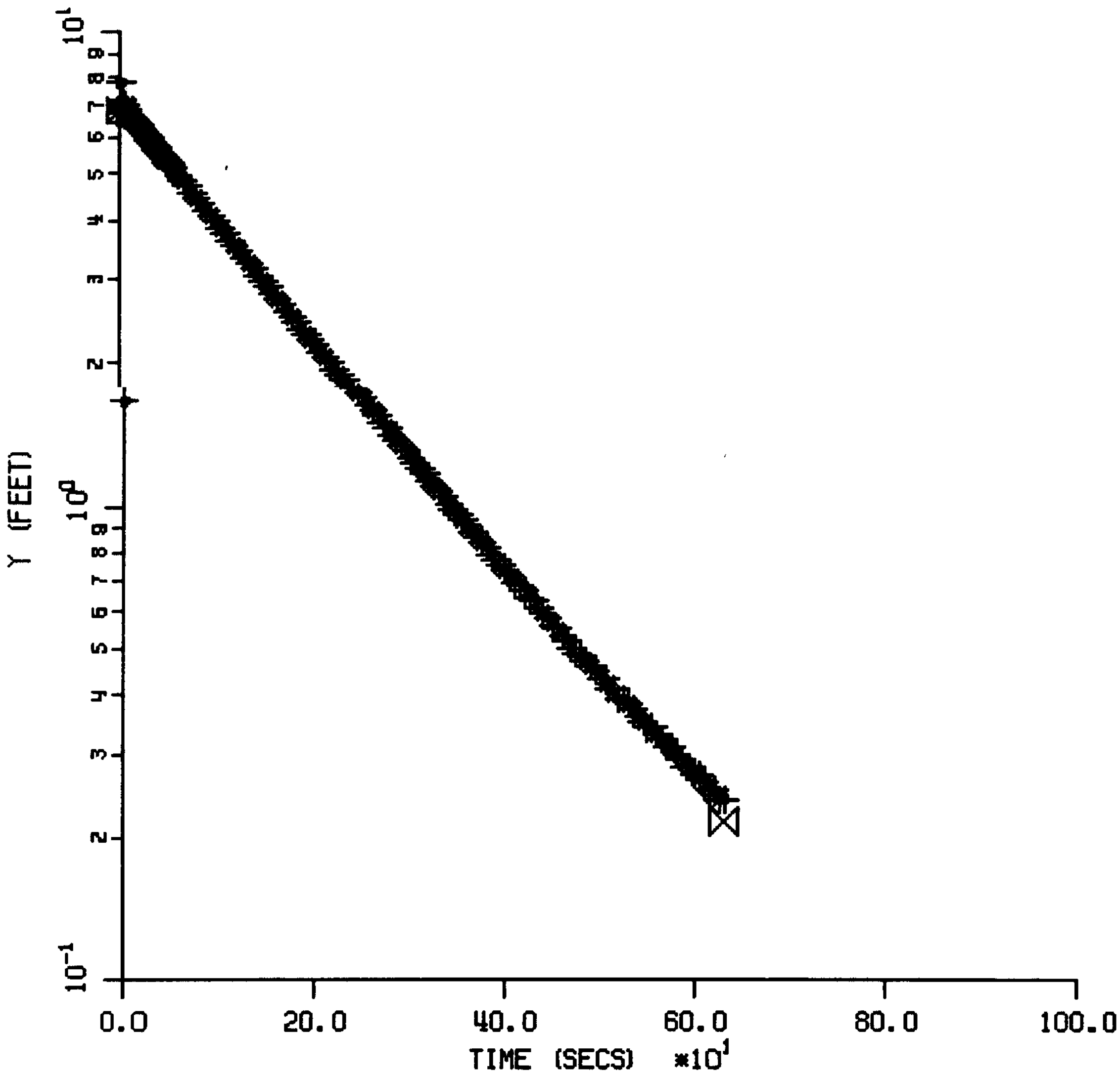
B = 0.0

C = 2.9

Y-INTERCEPT = 4.1

SLOPE = -0.0

NSL/ECC
ECCMW19B TEST 1



K (CM/S) = 0.000247

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 16.0

COEFFICIENTS

A = 0.0

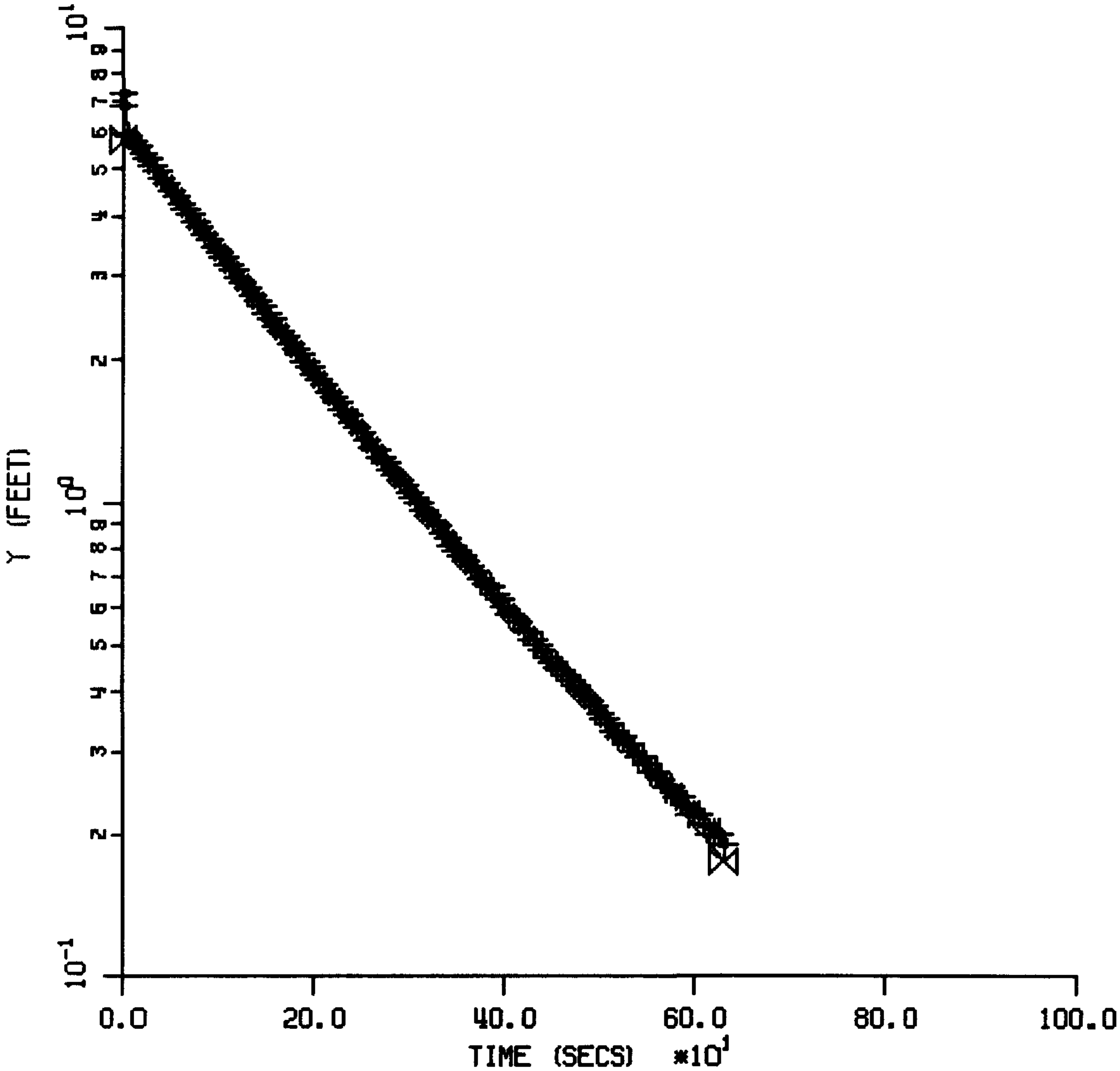
B = 0.0

C = 4.7

Y-INTERCEPT = 6.8

SLOPE = -0.0

NSL/ECC
ECCMW19B TEST 2



K (CM/S) = 0.000250

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 16.0

COEFFICIENTS

A = 0.0

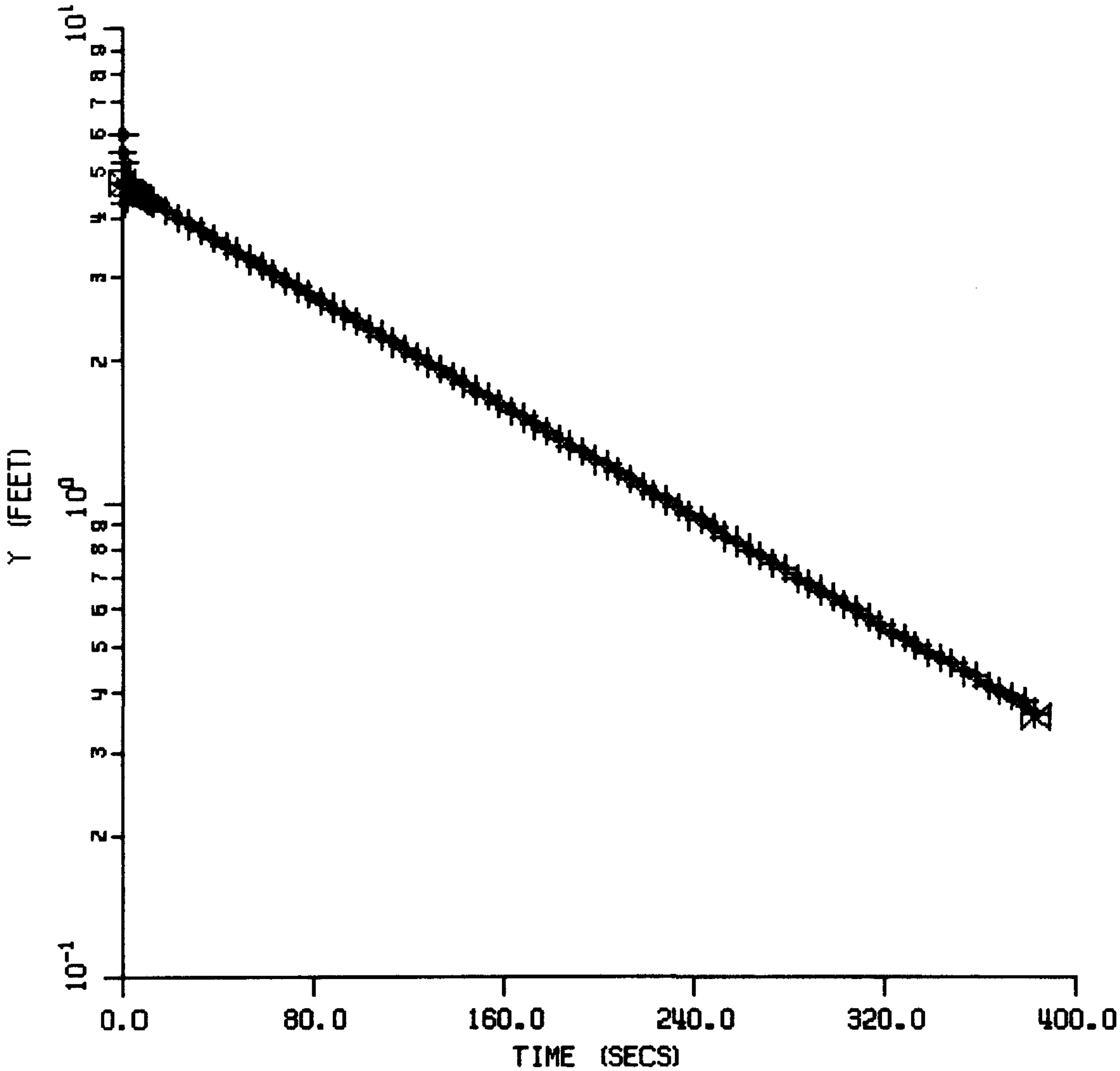
B = 0.0

C = 4.7

Y-INTERCEPT = 5.8

SLOPE = -0.0

NSL/ECC
ECCMW19B TEST 3



K (CM/S) = 0.000304

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 16.0

COEFFICIENTS

A = 0.0

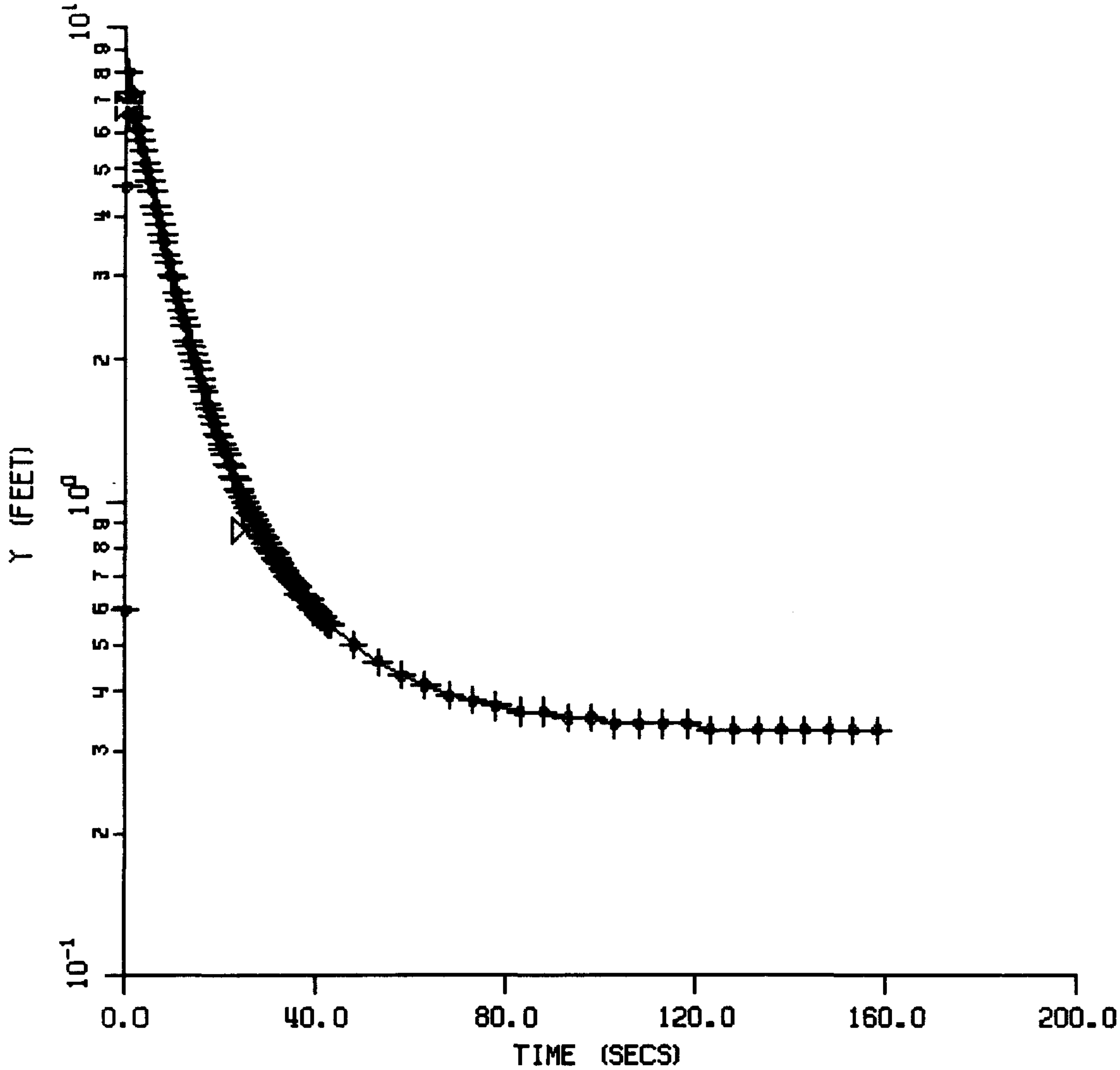
B = 0.0

C = 4.7

Y-INTERCEPT = 4.7

SLOPE = -0.0

NSL/ECC
ECCMW20 TEST 1



K (CM/S) = 0.003757

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 23.0

COEFFICIENTS

A = 0.0

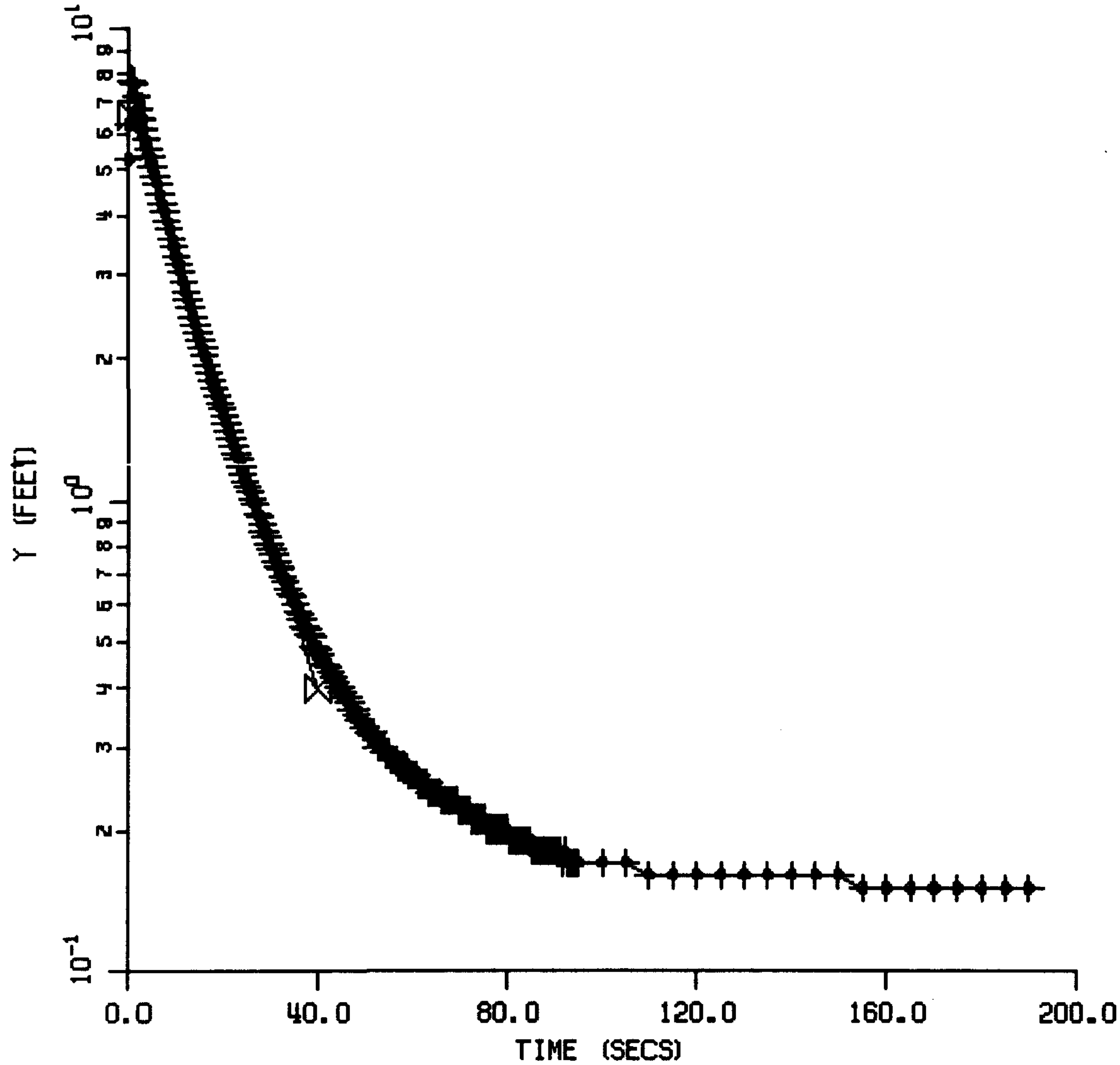
B = 0.0

C = 4.7

Y-INTERCEPT = 7.1

SLOPE = -0.0

NSL/ECC
ECCMW20 TEST 2



K (CM/S) = 0.003181

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 23.0

COEFFICIENTS

A = 0.0

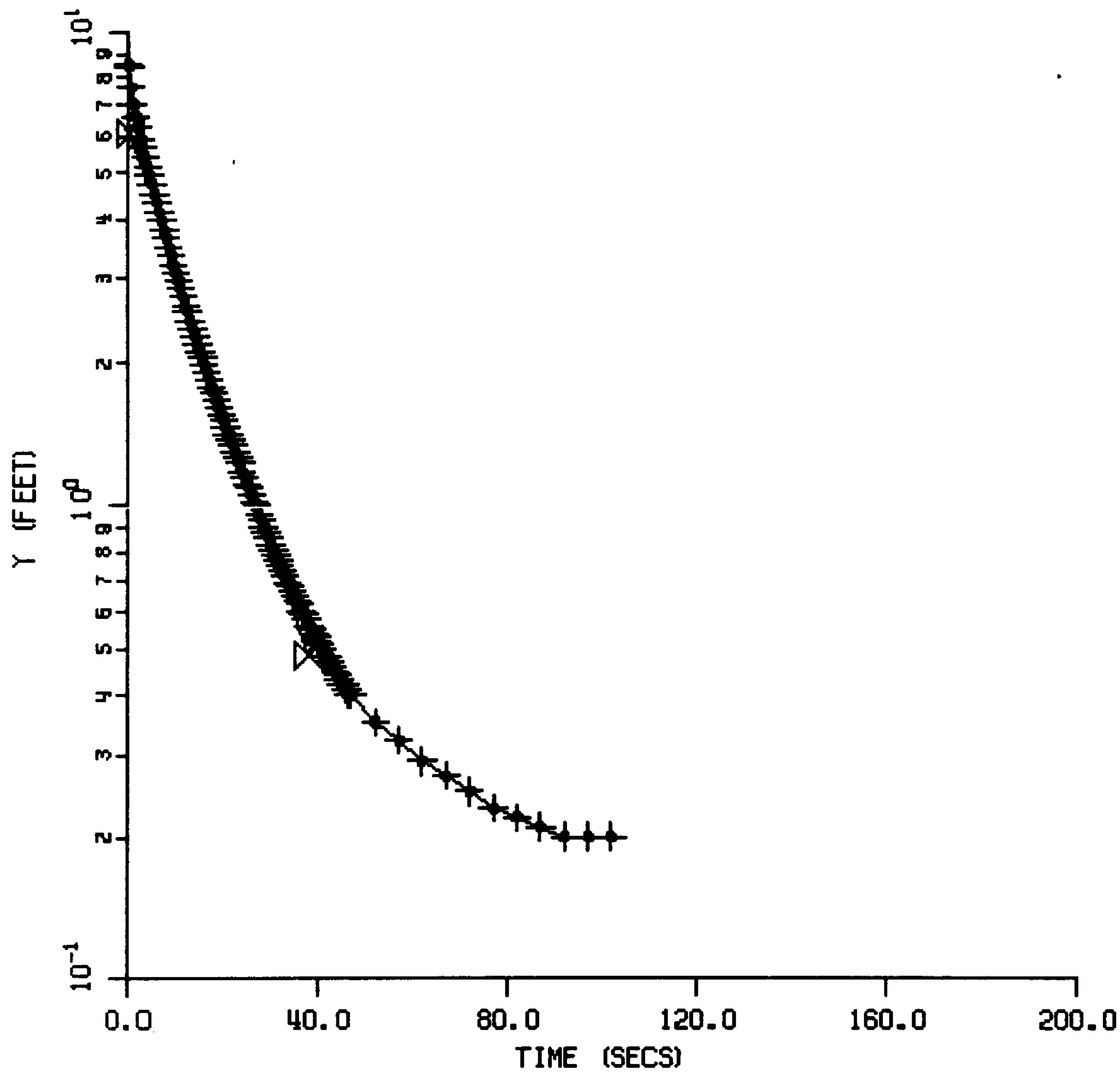
B = 0.0

C = 4.7

Y-INTERCEPT = 6.8

SLOPE = -0.0

NSL/ECC
ECCMW20 TEST 3



K (CM/S) = 0.002050

WELL SPECS. (FEET)

SCREEN LENGTH = 15.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 23.0

COEFFICIENTS

A = 0.0

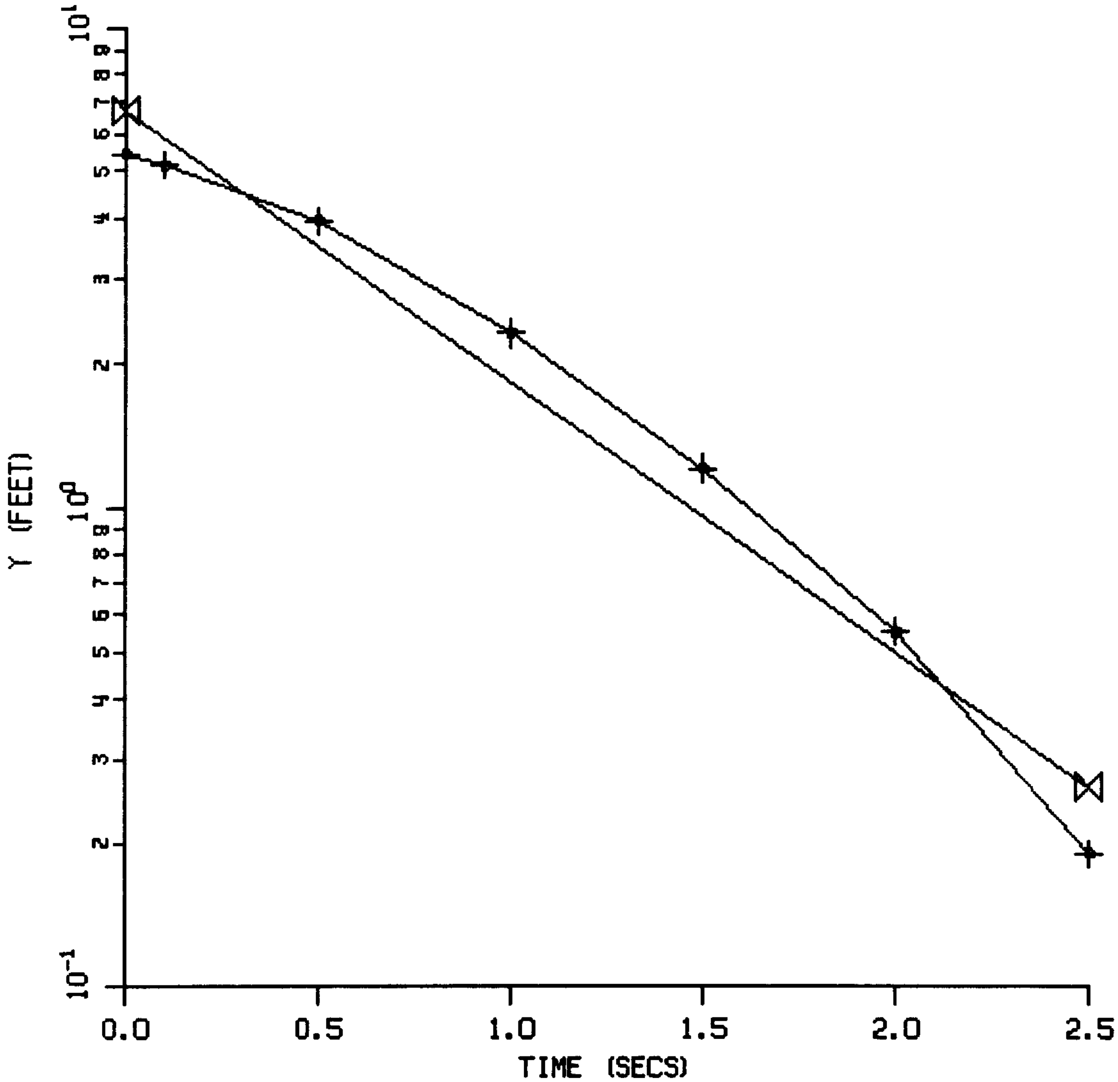
B = 0.0

C = 6.3

Y-INTERCEPT = 6.3

SLOPE = -0.0

NSL/ECC
ECCMW21 TEST 1



K (CM/S) = 0.040843

WELL SPECS. (FEET)

SCREEN LENGTH = 15.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 21.0

COEFFICIENTS

A = 0.0

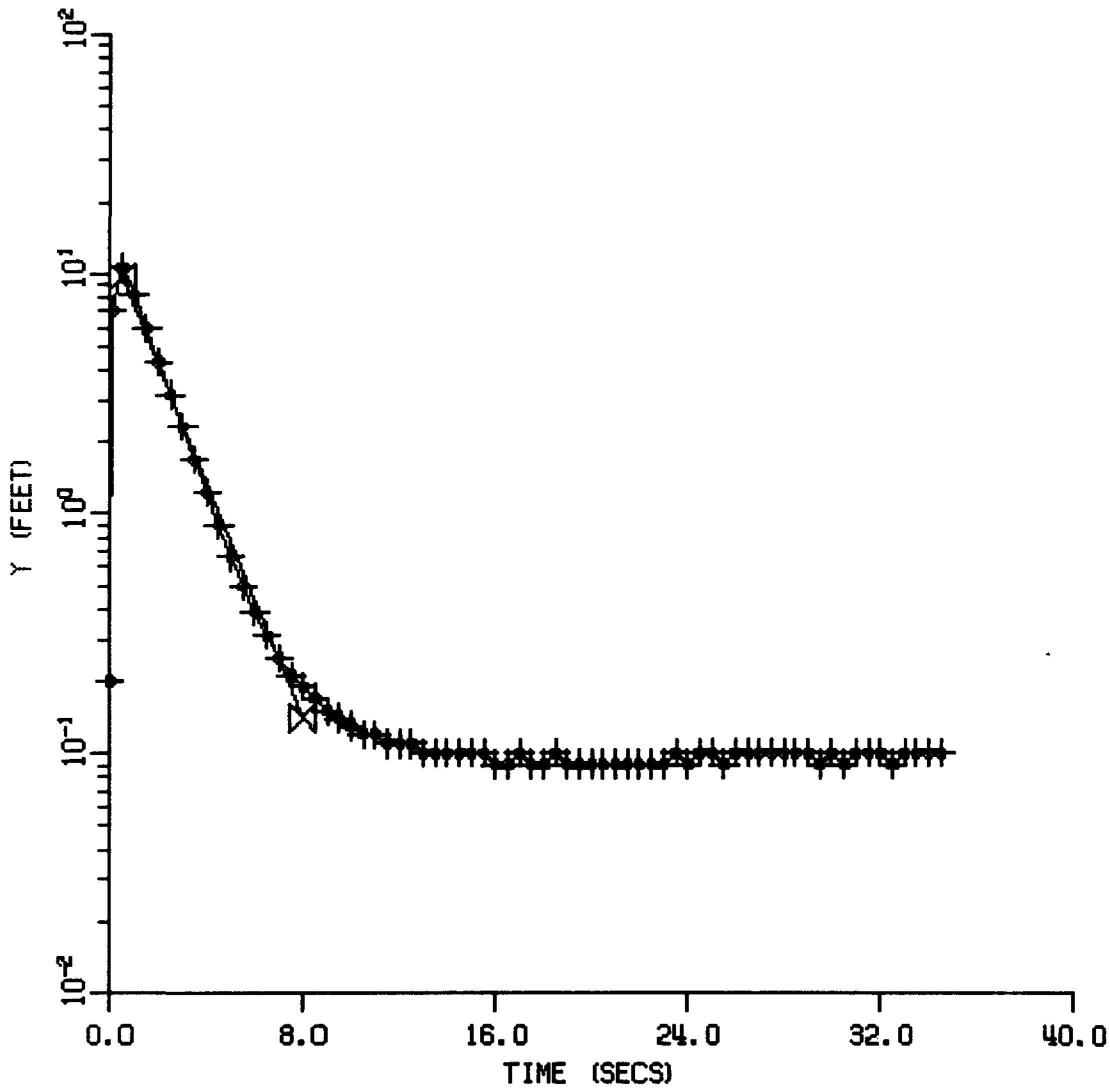
B = 0.0

C = 6.3

Y-INTERCEPT = 6.7

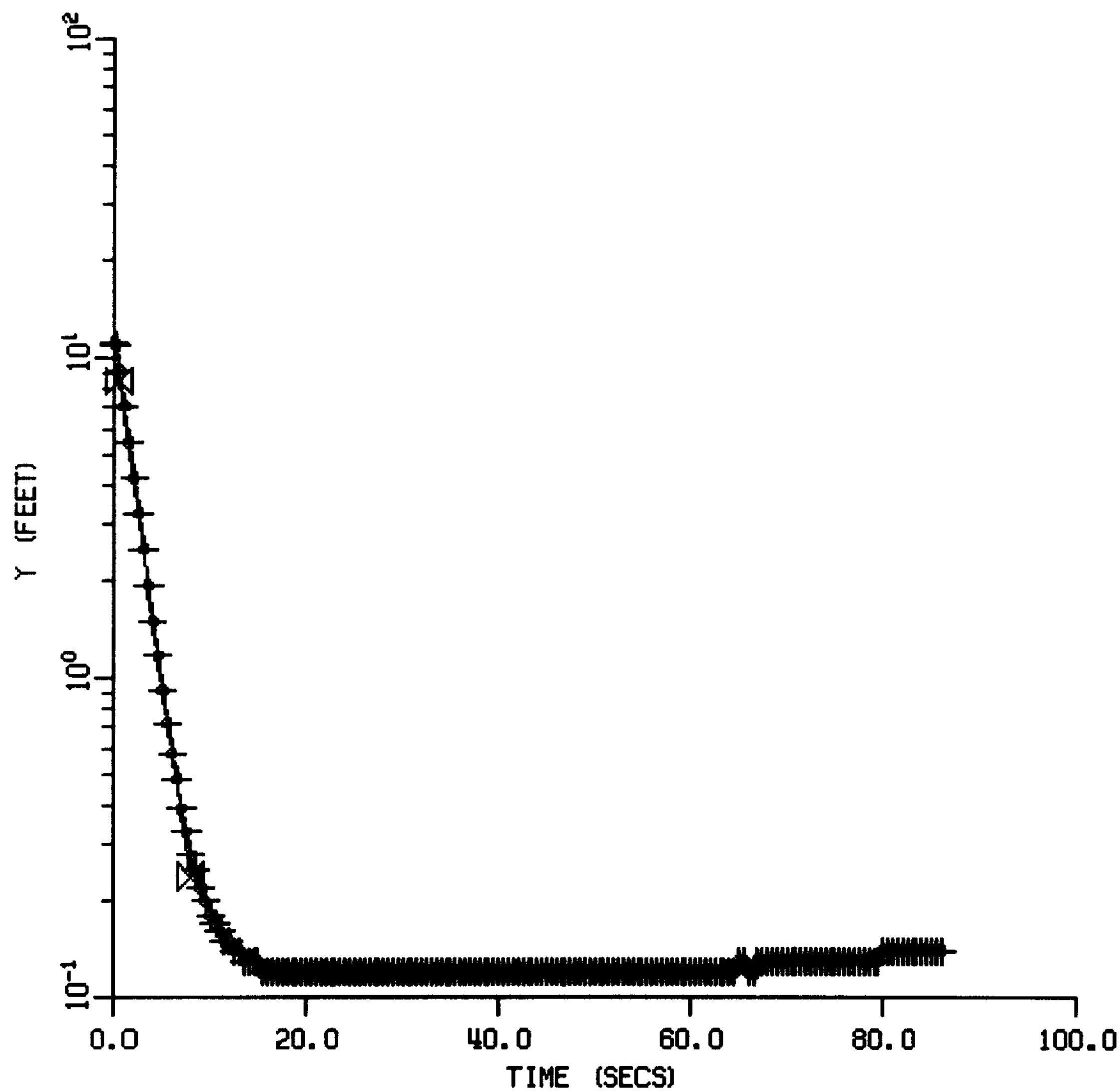
SLOPE = -0.6

NSL/ECC
ECCMW21 TEST 2



K (CM/S) = 0.017767	COEFFICIENTS
WELL SPECS. (FEET)	A = 0.0
SCREEN LENGTH = 15.0	B = 0.0
WELL SCREEN/BORE RADIUS = 0.1	C = 6.3
WELL CASING RADIUS = 0.1	Y-INTERCEPT = 12.9
AQUIFER THICKNESS = 21.0	SLOPE = -0.2

NSL/ECC
ECCMW21 TEST 3



K (CM/S) = 0.014962

WELL SPECS. (FEET)

SCREEN LENGTH = 15.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 21.0

COEFFICIENTS

A = 0.0

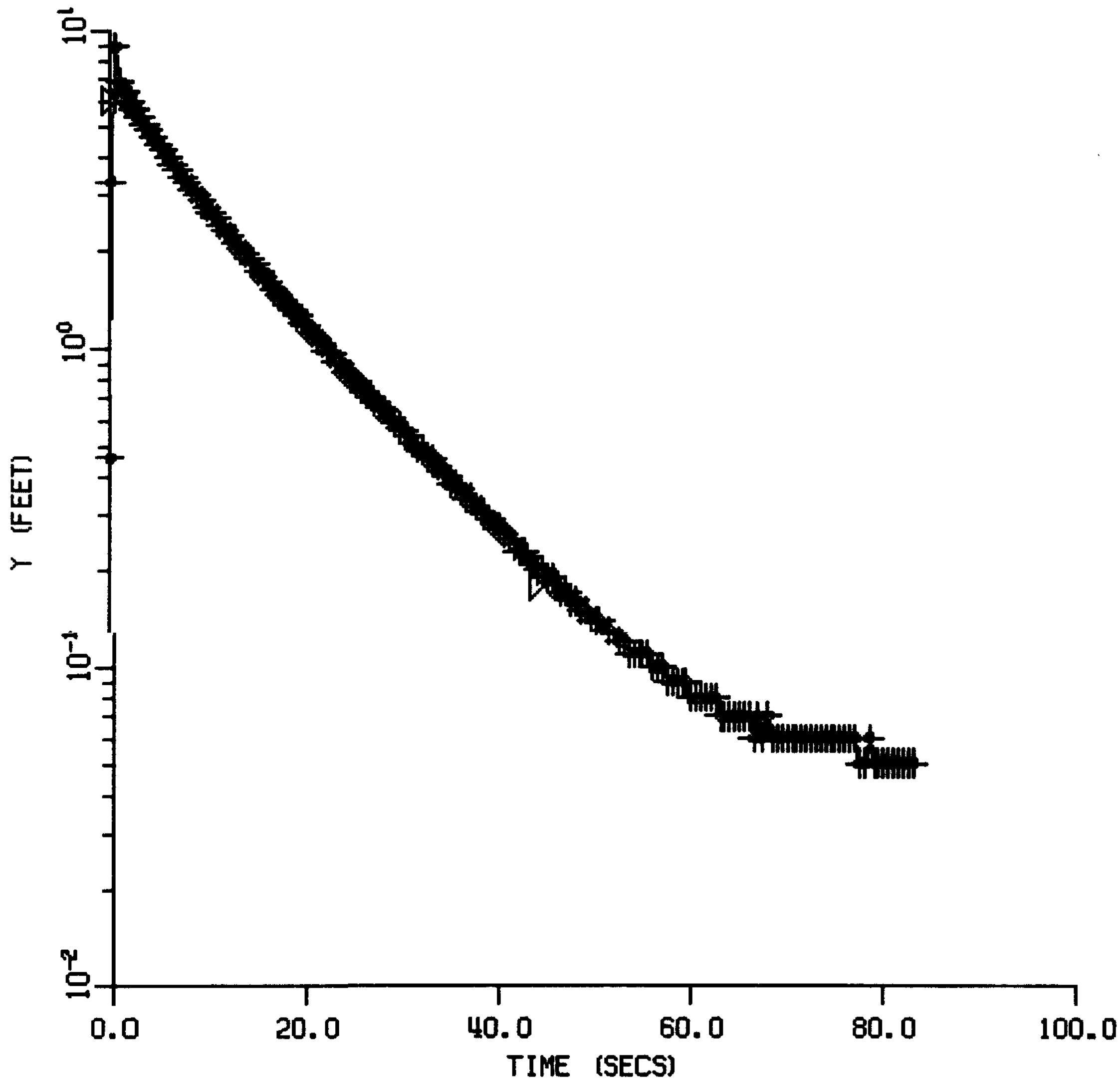
B = 0.0

C = 6.3

Y-INTERCEPT = 10.7

SLOPE = -0.2

NSL/ECC
ECCMW22 TEST 1



K (CM/S) = 0.003601

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 26.0

COEFFICIENTS

A = 0.0

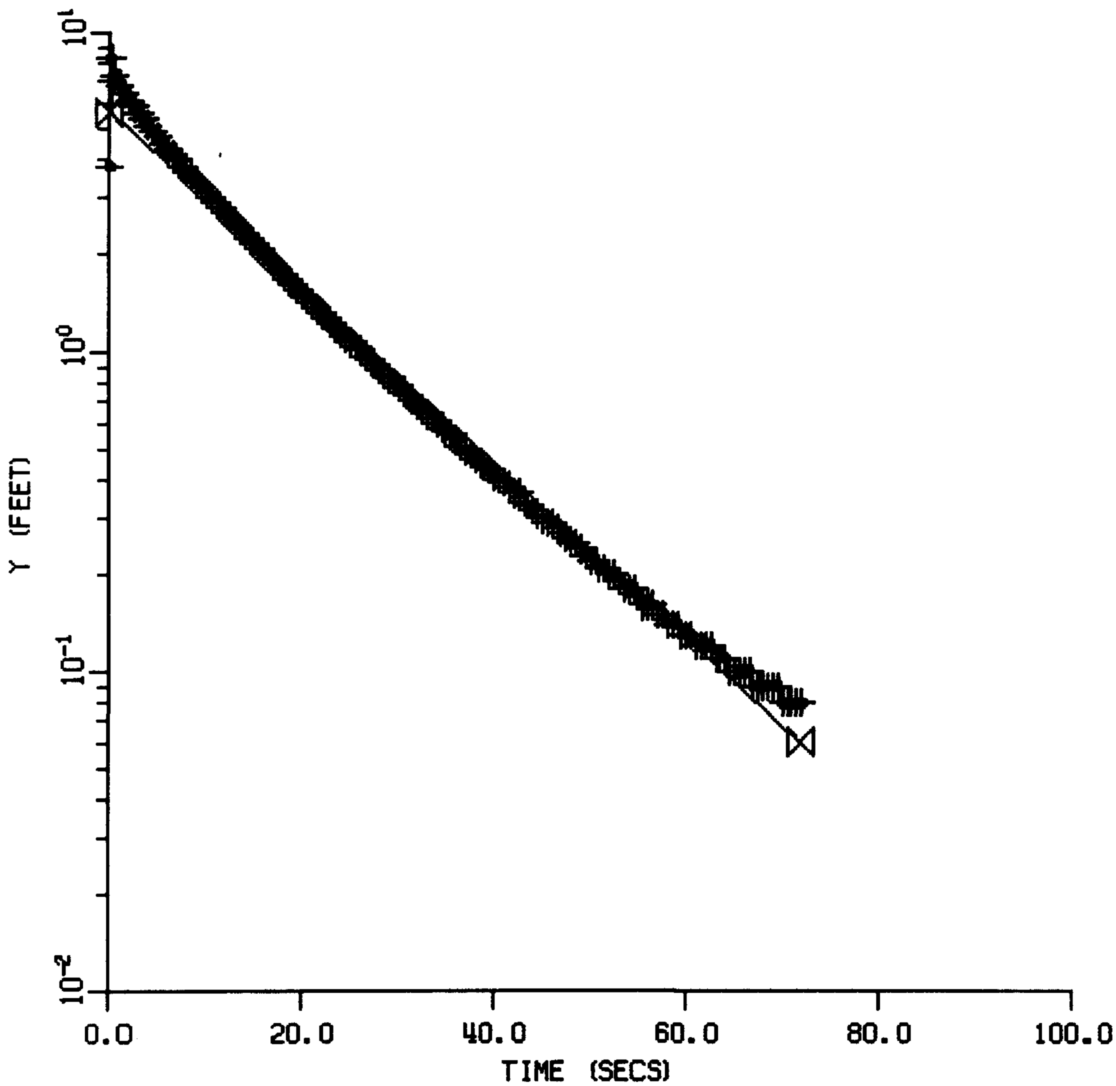
B = 0.0

C = 4.7

Y-INTERCEPT = 6.3

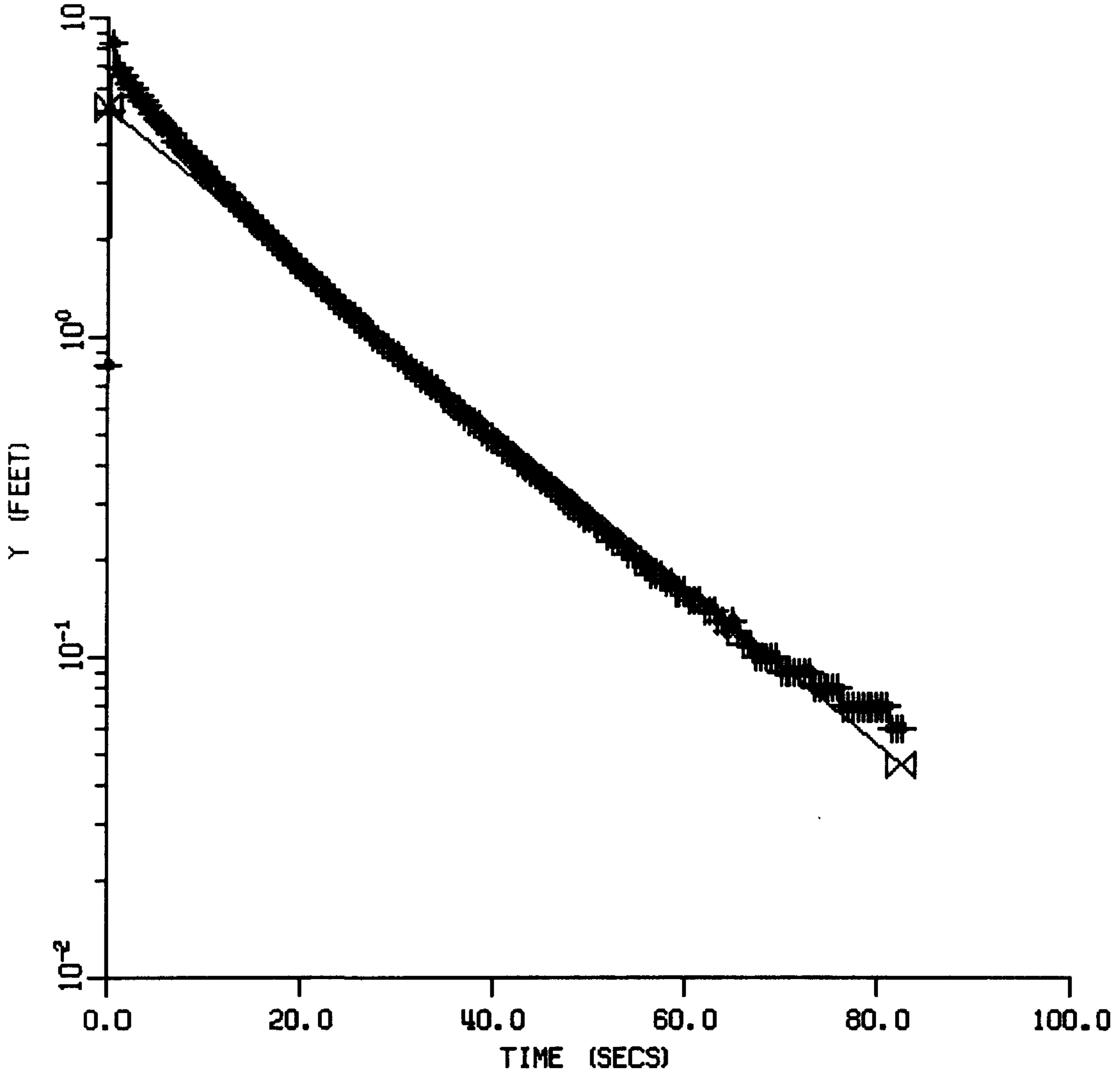
SLOPE = -0.0

NSL/ECC
ECCMW22 TEST 2



K (CM/S) = 0.002867	COEFFICIENTS
WELL SPECS. (FEET)	A = 0.0
SCREEN LENGTH = 10.0	B = 0.0
WELL SCREEN/BORE RADIUS = 0.1	C = 4.7
WELL CASING RADIUS = 0.1	Y-INTERCEPT = 5.6
AQUIFER THICKNESS = 26.0	SLOPE = -0.0

NSL/ECC
ECCMW22 TEST 3



K (CM/S) = 0.002608

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 26.0

COEFFICIENTS

A = 0.0

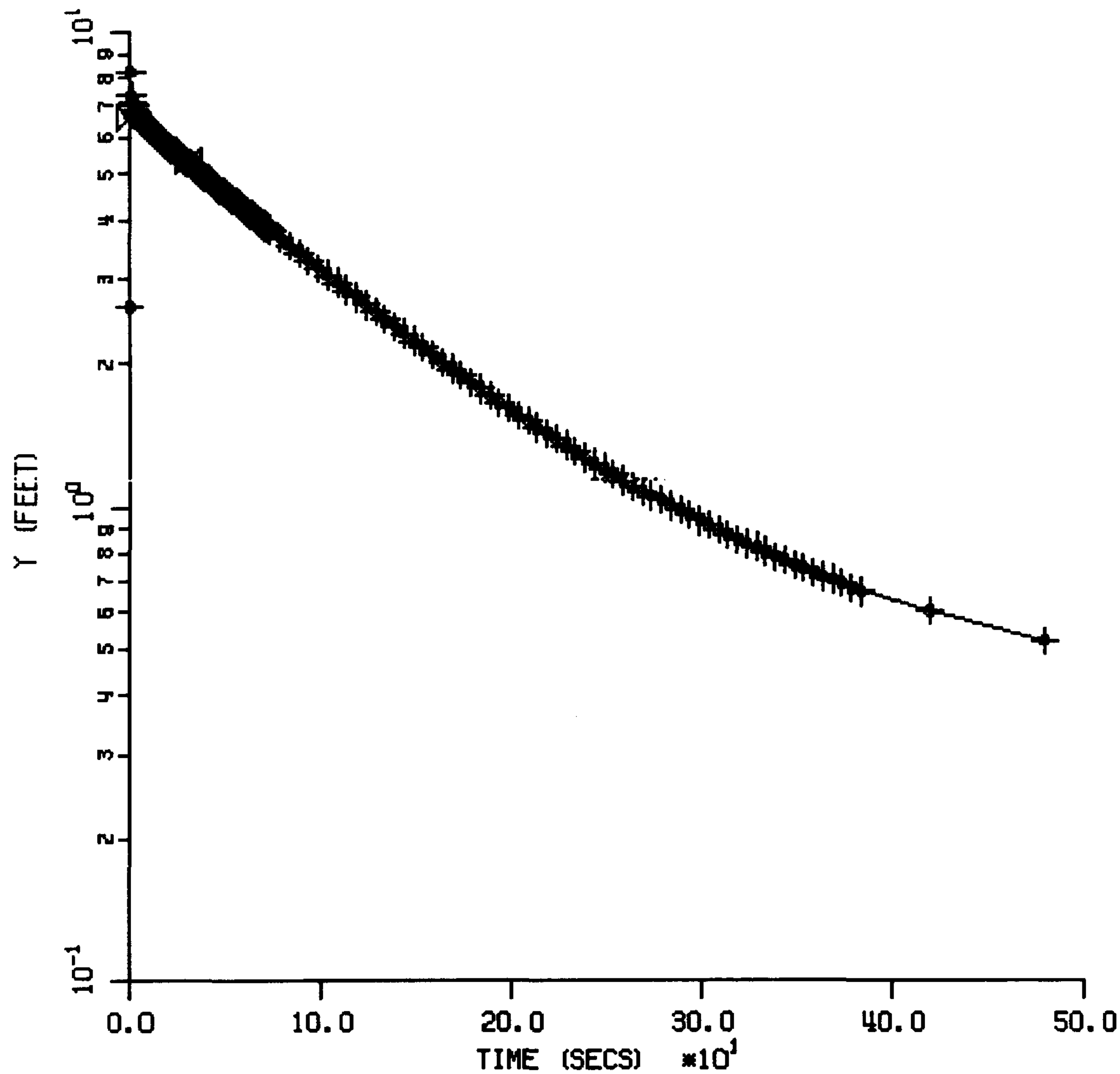
B = 0.0

C = 4.7

Y-INTERCEPT = 5.2

SLOPE = -0.0

NSL/ECC
ECCMW23 TEST 1



K (CM/S) = 0.000299

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 16.0

COEFFICIENTS

A = 0.0

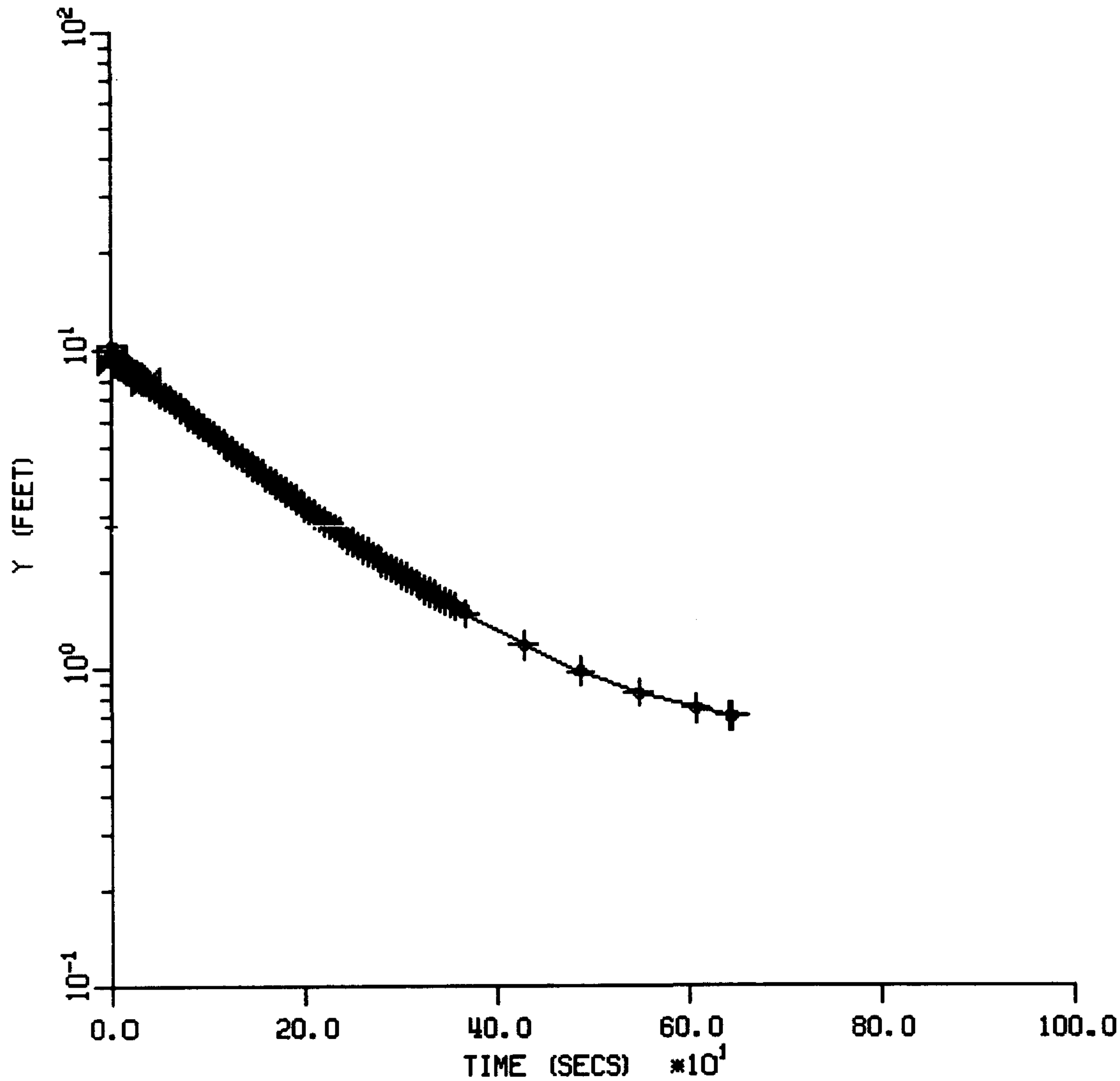
B = 0.0

C = 4.7

Y-INTERCEPT = 6.6

SLOPE = -0.0

NSL/ECC
ECCMW23 TEST 2



K (CM/S) = 0.000188

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 16.0

COEFFICIENTS

A = 0.0

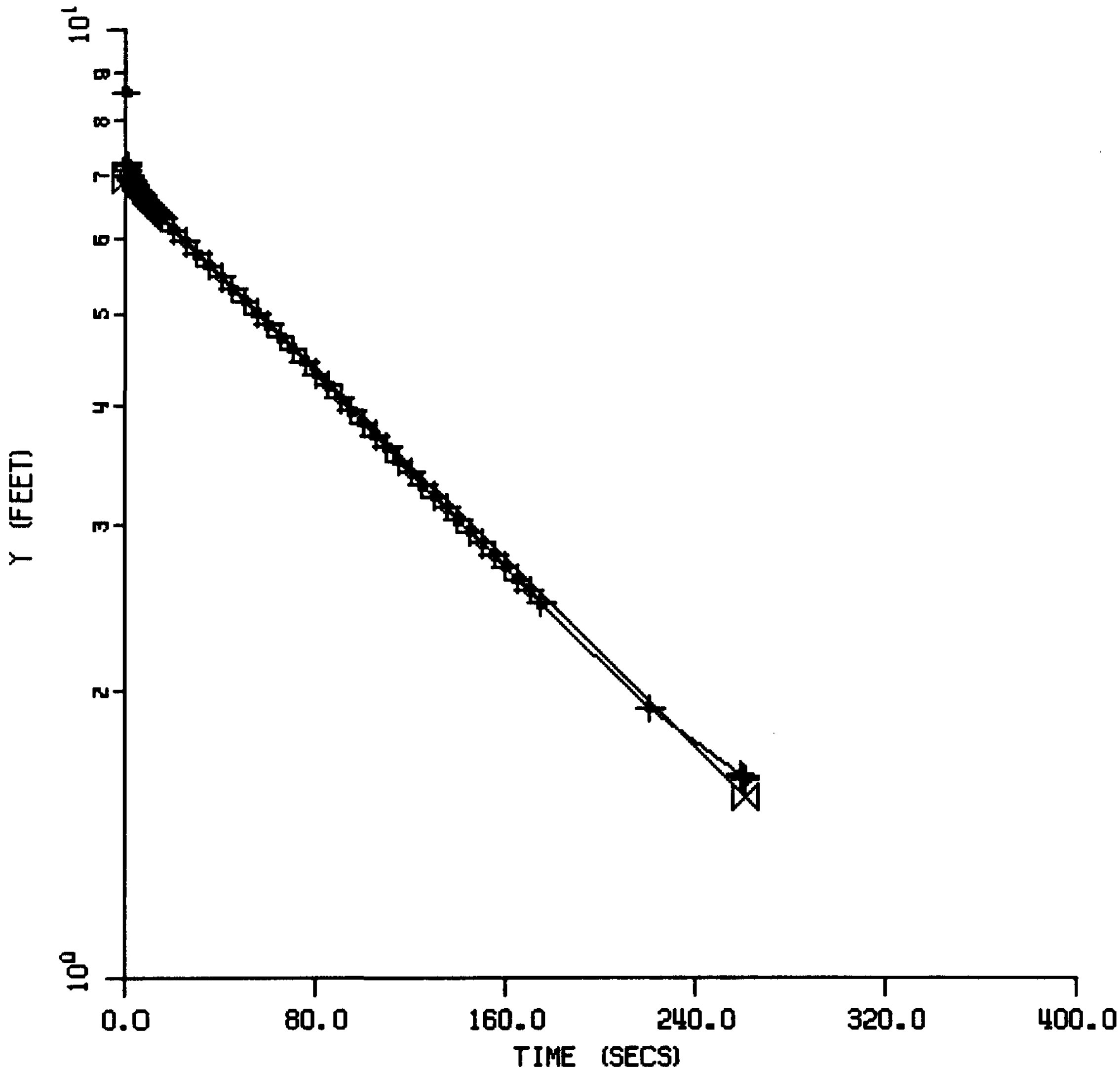
B = 0.0

C = 4.7

Y-INTERCEPT = 9.4

SLOPE = -0.0

NSL/ECC
ECCMW23 TEST 3



K (CM/S) = 0.000245

WELL SPECS. (FEET)

SCREEN LENGTH = 10.0

WELL SCREEN/BORE RADIUS = 0.1

WELL CASING RADIUS = 0.1

AQUIFER THICKNESS = 16.0

COEFFICIENTS

A = 0.0

B = 0.0

C = 4.7

Y-INTERCEPT = 6.9

SLOPE = -0.0